

**REMEDIAL INVESTIGATION/FEASIBILITY STUDY
TASK WORK PLAN**

**STATE MARINE SUPERFUND SITE
PORT ARTHUR, JEFFERSON COUNTY, TEXAS**

CERCLA ID NO. TXD099801102

Prepared for

**U.S. ENVIRONMENTAL PROTECTION AGENCY
Region 6**

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Prepared by

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July 2001

WESTON W.O. No. 20074.515.012.9989

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**STATE MARINE SUPERFUND SITE
PORT ARTHUR, JEFFERSON COUNTY, TEXAS**

CERCLA ID NO. TXD099801102

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LIST OF ACRONYMS

ARARs	Applicable or Relevant and Appropriate Requirements
ARC	Alternative Remedial Contract
ASTs	Aboveground storage tanks
bgs	below ground surface
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLP	Contract Laboratory Program
COI	Conflict-of-Interest
COPCs	Chemicals of potential concern
CWA	Clean Water Act
EPA	U.S. Environmental Protection Agency
ESI	Expanded Site Inspection
FCAA	Federal Clean Air Act
FTL	Field Team Leader
GPS	Global Positioning System
HASP	Health and Safety Plan
HRS	Hazard Ranking System
IDW	Investigation-Derived Waste
LRC	Lauren Refining Company
MCL	Maximum Contaminant Level
NCP	National Contingency Plan
PAH	polycyclic aromatic hydrocarbon
PA/SSI	Preliminary Assessment/Screening Site Inspection

LIST OF ACRONYMS (Continued)

POLREPS	Pollution Reports
PPE	Probable Point of Entry
PTL	Project Team Leader
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
RD/RA	Remedial Design/Remedial Action
RI/FS	Remedial Investigation/Feasibility Study
RSCC	Regional Sample Coordination Center
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SHSC	Site Health and Safety Coordinator
SM	Sample Manager
SMS	State Marine Superfund Site
SOW	Statement of Work
SSI	Screening Site Inspection
SVOC	semivolatile organic compounds
TACB	Texas Air Control Board
TBT	Tributyltin
TDH	Texas Department of Health
TDS	Total Dissolved Solids
TDWR	Texas Department of Water Resources

LIST OF ACRONYMS (Continued)

TNRCC	Texas Natural Resource Conservation Commission
TWP	Task Work Plan
USDA SCS	U.S. Department of Agriculture Soil Conservation Service
VOCs	volatile organic compounds
WAM	Work Assignment Manager
WESTON	Weston, Inc.

1. INTRODUCTION

Roy F. Weston, Inc. (WESTON®) was contracted by U.S. Environmental Protection Agency (EPA) Region 6 to perform a Remedial Investigation/Feasibility Study (RI/FS) of the State Marine Superfund Site (hereafter referred to as SMS) located in Port Arthur, Jefferson County, Texas. The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Identification Number assigned to the site is TXD099801102. WESTON has prepared this site-specific Task Work Plan (TWP) to describe the technical scope of work to be performed at the SMS as part of the RI/FS.

This document represents the TWP for the RI/FS. The purpose of this document is to summarize available background information, to propose sample locations and field procedures that meet the requirements for conducting the RI/FS, and to develop and evaluate potential remedial alternatives for the site. As part of the TWP, a baseline human health and ecological risk assessment work plan, a site-specific Sampling and Analysis Plan (SAP), Quality Assurance Project Plan (QAPP), and a Health and Safety Plan (HASP) have been prepared and are included as appendices A through D. Appendix E presents the sampling and analysis plan for the off-site investigation of Sabine Lake adjacent to the SMS.

1.1 OBJECTIVES OF THE INVESTIGATION

WESTON is providing technical assistance to EPA Region 6 for the performance of the SMS RI/FS. The objectives of the RI/FS are to investigate the nature and extent of contamination at the SMS and to develop and evaluate the potential remedial alternatives for the SMS in accordance with CERCLA, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and with the National Oil and Hazardous Substances Pollution Contingency Plan (National Contingency Plan [NCP]).

The objectives of the RI/FS will be achieved by evaluating data obtained during the field investigation through the collection of sediment, soil, surface water, and groundwater samples from in and around the SMS. The activities that will be performed to meet the objectives of the RI/FS have been divided into the following 12 tasks:

- Task 1—Project Planning
- Task 2—Community Relations
- Task 3—Field Investigation
- Task 4—Sample Analysis and Data Validation
- Task 5—Data Evaluation
- Task 6—Risk Assessment
- Task 7—Treatability Studies
- Task 8—Remedial Investigation Report
- Task 9—Feasibility Study Process
- Task 10—RI/FS Report Preparation
- Task 11—Project Closeout
- Task 12—Project Management and Quality Assurance

The technical activities associated with the above-listed tasks are based on WESTON's understanding of the site background as summarized in Section 2. The site-specific objectives and activities for each task are described in greater detail in Section 3 of this TWP. WESTON will conduct these RI/FS tasks in general accordance with the following documents:

- *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (EPA/540/G-89/004).
- *Presumptive Remedies for Soils at State Superfund Sites* (TNRCC, RG-277, April 1997).
- *Presumptive Remedies for Groundwater at Texas Superfund Sites* (TNRCC, RG-337, January 1999).
- *Guidance for Conducting Site Inspections Under CERCLA* (EPA 540-G-92-021).
- *Guidance for Management of Investigation-Derived Waste During Site Inspections* (EPA 540/G-91/009).

1.2 WORK PLAN FORMAT

This TWP has been organized in a format that is intended to facilitate and effectively meet the objectives of the RI/FS. The TWP is organized into the following sections:

- Section 1—Introduction
- Section 2—Background
- Section 3—Scope of Work
- Section 4—Quality Assurance
- Section 5—Project Information
- Section 6—Reference List

All figures and tables referred to in this document are included at the end of each respective section.

2. BACKGROUND

This section presents a summary of background information for the SMS including site location and description, environmental setting, historical use, and previous investigations and results. This information was obtained from WESTON's site reconnaissance and Expanded Site Inspection (ESI) sampling activities, and removal activities recently completed. Additional sources of information include the CH2M Hill Technical Memorandum for the SMS (CH2M Hill, 1999).

2.1 SITE LOCATION AND DESCRIPTION

The SMS is located on Old Yacht Club Road on Pleasure Islet, a peninsula located approximately ½ mile southwest of the mouth of the Neches River in Jefferson County, Texas. A Site Location Map is provided as Figure 2-1. Overall, the site encompasses approximately 34 acres and is bounded to the north by the Palmer Barge Line site, to the west by Old Yacht Club Road, to the south by undeveloped property, and to the east by Sabine Lake. A Site Area Map is provided as Figure 2-2.

Pleasure Islet is a manmade landmass, consisting of dredge spoils generated during the construction and maintenance of the Sabine-Neches Canal, also called the Intercoastal Waterway. The canal was constructed between 1898 and approximately 1920 in the vicinity of Sabine Lake and the Neches River, between the current site location and the mainland. Pleasure Islet did not exist at the time as the area encompassing the site was actually part of the northern tip of Pleasure Islet. Between 1955 and 1957, a portion of the canal along the western side of Pleasure Islet was abandoned and a new canal was cut along the eastern and southern sides of Pleasure Islet. Pleasure Islet was created when a land bridge was constructed across the abandoned portions of the canal, between the northern tip of Pleasure Island and the mainland (CH2M Hill, 1999). A Site Plan is provided as Figure 2-3.

Vehicle access to the SMS is limited to a single dirt road originating at the western site border along Old Yacht Club Road. Within the SMS, dirt roads and trails connect various areas of historical barge-cleaning operations. Parallel to the shoreline are two sunken barge docks, which

form part of the shoreline. These two barges are the primary location where barges were moored during cleaning or maintenance. Several sunken barges and other unknown structures are located near the shoreline (CH2M Hill, 1999).

Old marine equipment, including cranes and marine salvage debris, are present on the dock barges and inland areas of the SMS. Several structures still exist on the SMS: a maintenance shed, a former office building, former wastewater treatment facility structures, and four aboveground storage tanks (ASTs) ranging in capacity from 1,000 to 5,000 gallons. Most of these structures are partially collapsed and appear abandoned except for the maintenance shed, which may still be in use. Several 55-gallon drums are present at the SMS. Numerous vehicles, including old cranes, pickup trucks, and several tractors, and tractor-trailers are parked at the site. None of the vehicles appear to be operational, and several seem in various states of salvage or repair. The soil around many of the vehicles is oil stained (CH2M Hill, 1999). Figure 2-3 also depicts the locations of the former wastewater impoundments, tar burn area, distillation column, and former location of the Lauren Refining Company (LRC) Tank Farm.

Sabine Lake is tidally influenced, and portions of the shoreline and former landfill are exposed between tidal influences as well as wave action generated by passing ships traveling along the Intercoastal Waterway.

2.2 ENVIRONMENTAL SETTING

Information concerning the environmental setting is presented in the subsections below.

2.2.1 METEOROLOGICAL CONDITIONS

The SMS is located in a moist, subhumid-to-humid, mild climate. The growing season averages 245 days per year. Precipitation is fairly evenly distributed throughout the year; although, summer and fall are frequently drought seasons, and December through May are often the wettest months. Total average annual precipitation is 52 to 56 inches per year. Maximum precipitation within a 24-hour period is about 5 ½ inches (WESTON, 2000). The potential for

evapotranspiration is high, resulting in a net annual precipitation of less than 12 inches (WESTON, 2000).

2.2.2 TOPOGRAPHY

Ground elevations range from sea level along the shoreline to a maximum of 11 feet above sea level in the north-central portions of the landmass (City of Port Arthur, Engineer's Office, 1998). The highest relief on Pleasure Islet is associated with the City of Port Arthur's former municipal landfill, which underlies most of the central and northern portions of the islet. Elevations range from approximately 2 to 7 feet above sea level on-site. Drainage on the islet is toward the adjacent waterways with surface drainage on the SMS occurring to the east-southeast.

2.2.3 HYDROLOGIC SETTING

The SMS is located directly along the shores of Sabine Lake, within the 100-year flood plain, approximately ½ mile southwest of the point where the Neches River enters the Sabine-Neches Canal. Sabine Lake is defined as a bay or estuary (TNRCC, 1998). Sabine Lake not only receives water from Jefferson County and the basin of the Neches River, but also from Sabine River. This water passes into the Gulf of Mexico through Sabine Pass, a body of salt water lying between Jefferson County and Cameron Parish, Louisiana (USDA SCS, 1965).

There is no associated overland migration route due to the proximity of the SMS and Sabine Lake. Surface water run-off from the SMS discharges directly into Sabine Lake. The probable point of entry (PPE) for a release of hazardous substances begins at the bulkhead and dock of the SMS and Sabine Lake.

2.2.4 GEOLOGIC SETTING

Information related to the geologic setting is presented below.

2.2.4.1 Local Soil Conditions

The soils at the SMS area are considered fill material and are primarily the result of dredging operations conducted along the Sabine-Neches Canal.

The Soil Conservation Service (SCS) Soil Survey For Jefferson County, Texas, indicates that the soils at the site consist of Made Land (USDA SCS, 1965). This land type consists of materials that have been excavated from canals, ditches, and waterways; the material is dominantly clay, but in some places it is a mixture of clay loam, sand, and shells. Specific depth, texture, and engineering classification are not available because of variability.

2.2.4.2 Regional Geology

The SMS is located on the seaward margin of the southeastern Gulf Coastal Plain of Texas. The Cenozoic sediments that underlie the Coastal Plain are tens of thousands of feet thick at the coastline. These sediments consist of sand, silt, and clay and represent depositional environments ranging from nonmarine at the outcrops of most units to marine where the units may carry a distinctive suite of fossils. Oscillations of ancient seas and changes in amount and source sediments that were deposited caused facies changes downdip and along strike. Subsidence of the basin of deposition along with the rising of the land surface caused the stratigraphic units to thicken Gulfward. Growth faults greatly increased the thickness of some stratigraphic units in short distances (TNRCC, 1998).

The sediments of the Coastal Plain area consist of a localized fill and spoil material, which is dredged from the waterways and used to build up or create new land surfaces. Also included in the Coastal Plain are Quaternary alluvium, made up of clay, silt, and sand; Beaumont clay; Montgomery Formation; Bentley Formation; and the Willis Sand. All of these formations, with the exception of the fill and spoil material, make up the Chicot Aquifer. Underlying these deposits are the Tertiary stratigraphic units: the Goliad Sand, Fleming Foundation, Oakville Sandstone, and the Catahoula Sandstone. The Evangeline Aquifer is located in the first Tertiary stratigraphic unit; the Goliad Sand is Pliocene in age (TNRCC, 1998; TDWR, 1979).

2.2.4.3 Site Geology

According to information provided in the *Geologic Atlas of Texas*, Houston Sheet, the SMS is situated on fill and soil material obtained during dredging operations along the Intercoastal Waterway (Bureau of Economic Geology, 1982).

The description of the near-surface lithology of the SMS has been inferred based on soil samples collected during WESTON's 2000 ESI field activities at Palmer Barge site since the two sites are located adjacent to one another. Based on field observations made during the Palmer Barge ESI, soils at SMS can be described as clay, sand, and silt deposits to a depth of approximately 4 feet below ground surface (bgs) (terminal depth of shallow soil borings). Most of this near surface material appeared to be a low to moderate plasticity clay, with sparse silt interbeds and minor lenses of fine-grained sand. Wood fragments and glass particles were encountered in some of the shallow borings at the site (WESTON, 2000). Note, the near-surface lithology needs to be confirmed as part of the planned RI/FS activities at SMS.

2.2.5 HYDROGEOLOGIC SETTING

Information related to the hydrogeologic setting is presented below.

2.2.5.1 Regional Hydrogeology

The principle source of fresh to saline groundwater in the study area is the Gulf Coast Aquifer, which consists of alternating beds of clay, silt, sand, and gravel that are hydrologically connected and form a large, leaky artesian aquifer system. The Gulf Coast Aquifer ranges in age from Miocene to Holocene and is composed of sediments of the Catahoula, Oakville, Fleming, Goliad, Willis, Bentley, Montgomery, and Beaumont Formations as well as the Quaternary alluvium. The Gulf Coast Aquifer has been subdivided into the Chicot Aquifer composed of the Willis, Bentley, Montgomery, and Beaumont Formations and the Evangeline Aquifer that includes the Goliad Formation. Depth to groundwater ranges from 2 to 60 feet based on private wells drilled within a 4-mile radius of the site (TNRCC, 1998).

The quality of groundwater produced from the Gulf Coast Aquifer is good, containing less than 1,000 milligram per liter (mg/L) of total dissolved solids (TDS). However, areas of more highly mineralized water exist south of Beaumont to the coast in Jefferson County (TNRCC, 1998). Because of the underlying former City of Port Arthur Landfill, which precludes use of shallow groundwater, and the site's proximity to brackish surface water, groundwater is believed to be nonpotable.

2.2.5.2 Site Hydrogeology

The description of the site hydrogeology has been inferred based on information collected during WESTON's ESI field activities at Palmer Barge Line Site. The depth to the shallowest water-bearing zone beneath the site is estimated to be approximately 4 feet bgs. However, no monitoring wells were installed during the ESI field activities. A true determination as to the depth to groundwater and flow direction was not measured during the ESI and needs to be established as part of the planned RI/FS activities at SMS (WESTON, 2000).

2.3 HISTORICAL USE

Prior to 1957, Pleasure Islet was part of Pleasure Island and did not exist in its current state. From about 1938 and 1955, few changes were observed in the northern portions of Pleasure Island. The islet was heavily vegetated and undeveloped with no evidence of roads or structures. The islet received dredge spoils, probably during the initial intercoastal canal construction, as well as routine maintenance. Ownership of the Pleasure Islet was transferred from the State of Texas to the City of Port Arthur, Texas, about 1955. Development of the islet and the SMS site began after 1957, following construction of the land bridge across the abandoned portions of the Sabine-Neches Canal (CH2M Hill, 1999) .

The City of Port Arthur began municipal landfill operations in approximately 1963 on the northern and central portions of the islet. Initially, the landfill consisted of a burn pit where wastes were incinerated. By December 1969, burn operations were discontinued, and the landfill was used solely for disposal of wastes. Between 1969 and 1972, landfill disposal operations expanded to include the central and northern portions of the site as well as property north of the

BACKGROUND

site. Between 1972 and 1974, disposal activities were generally concentrated in the northern parts of the islet. Trench methods of land filling were employed for disposal of waste materials. Fifty-foot-wide trenches were excavated to approximately 6 to 9 feet, depending on ground elevations. Approximately 6 inches of cover was placed over the waste every 2 days during operation, and once the entire trench was filled, a minimum of 2 feet of soil was placed over the entire area. The City of Port Arthur closed the landfill in December 1974, in accordance with Texas Department of Health (TDH) regulations, which required covering the entire landfill with approximately 2 feet of fine-grained fill material. The cover material is believed to be dredge spoils that originated on the islet (CH2M Hill, 1999) .

SMS operations began about 1973 under the names of State Welding and Marine Works and the Golden Triangle Shipyard. The specific operations at the site at that time are unknown but are likely to have included marine salvage and repairs, including off-loading of petroleum products and bulk storage.

The construction of wastewater impoundments in the northwestern portion of the site was also reported. The impoundments were reportedly unlined, earthen diked areas, approximately 2 acres in size, which were used to store oil and wastewater from barge-cleaning operations (CH2M Hill, 1999) .

Based on the Texas Air Control Board (TACB) and Texas Department of Water Resources (TDWR) inspection reports, wastewater from barge-cleaning operations was directed to two ASTs, then pumped to the wastewater impoundments. Some of the oil from the tanks was diverted to an old ship (on land), which was being used as an oil/water separator. Oil from the separator was collected for reuse, potentially on-site. TACB reported that waste oil from the impoundments was being recovered by a contractor and disposed off-site. Some of the oil and wastewater reportedly infiltrated the underlying soils and landfill wastes. No records of off-site waste oil disposal were identified (CH2M Hill, 1999) .

In August 1980, a TDWR inspection reported that facility modifications had been made to allow process waste oils to be converted into bunker fuels. According to TDWR records, the facility modifications included a distillation column and three ASTs: one 20,000-barrel tank and two

10,000-barrel tanks. Additional, smaller tanks were later constructed in the same area. A TDWR inspection report associated these storage tanks with the Lauren Refining Company (LRC) (also owned and operated by the owners of the SMS). It is unknown when LRC first initiated operations at the site; although, it is likely to have occurred sometime in 1980. TDWR inspection records from July 1982 report that approximately 5,100 barrels of the oil/water mixture contained in the impoundments were pumped to ASTs located at the LRC (CH2M Hill, 1999).

In July 1983, TDWR conducted an evening inspection at the site, following an anonymous call indicating that barges of toxic waste were to be pumped into the Sabine Lake. TDWR personnel documented direct discharges of barge waste into a Golden Triangle Shipyard dock barge, which was moored at the site. The dock barge contained holes, thus permitting contaminated wastewater to flow directly into the Sabine Lake (CH2M Hill, 1999).

2.4 PREVIOUS INVESTIGATIONS AND RESULTS

The most comprehensive sampling effort performed to date at SMS occurred in 1995 as part of a Site Sampling event conducted by TNRCC in support of a Hazardous Ranking System Documentation Report (TNRCC, 1996 and 1997).

The 1995 sampling event included collection of soil, sediment, and surface water samples by TNRCC personnel. The samples were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides and polychlorinated biphenyls (PCBs), metals, and cyanide. Sampling for tributyltin (TBT) was not performed. TBT is an antifouling paint additive frequently used in barge cleaning operations (CH2M Hill, 1999). Additional sediment and surface water samples were obtained by the TNRCC in 1995 in the Sabine Lake area to assess background conditions. A summary of maximum SVOC and metals present in soil and sediment samples is presented in Tables 2-1 and 2-2.

A summary of investigation results is provided below and was taken from the CH2M Hill Technical Memorandum, which summarized the TNRCC sampling events (CH2M Hill, 1999).

Soil Samples:

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BACKGROUND

- VOCs were detected infrequently and at relatively low levels in several soil samples. Two of the detected VOCs, acetone and methylene chloride, are potential laboratory contaminants and may not be site-related. SVOCs including carcinogenic benzo(a)pyrene, benzo(a)anthracene, benzo(a)fluoranthene, benzo(b)fluoranthene, and benzo(k)fluoranthene were encountered in all the soil samples collected except two. Pesticides and PCBs were detected sporadically across the entire site.
- Metals were identified in all the soil samples collected from the site. Elevated levels of aluminum, chromium, copper, iron, lead, and zinc were encountered across the entire site.

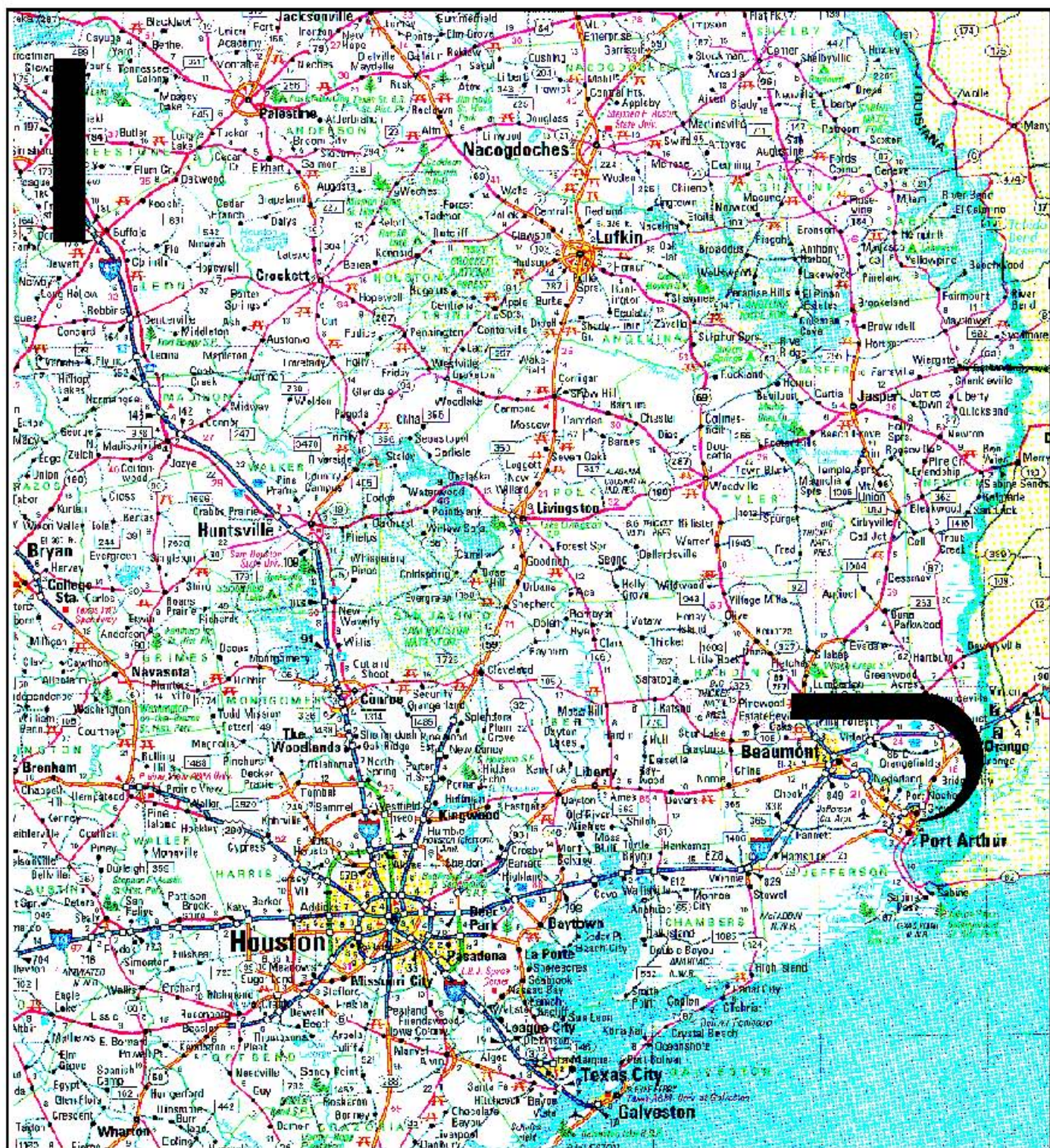
Sediment Samples:

- Thirty-four sediment samples, including duplicates, were obtained from on-site and off-site areas. Eight background samples were collected from areas around Sabine Lake.
- VOCs were detected infrequently and at relatively low levels in several samples. Acetone and methylene chloride are potential laboratory contaminants and may not be site-related. SVOCs consisted of benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, and benzo(k)fluoranthene. Aroclor-1242 and lindane were each detected in one sample.
- Metals including arsenic, copper, iron, lead, manganese, mercury, nickel, and zinc were identified in all the sediment samples.

Surface Water Samples:

- Nine surface water samples were collected from Sabine Lake. No VOCs or pesticides/PCBs were detected. Detected SVOCs included benzo(g,h,i)perylene and bis(2-Ethylhexyl)phthalate.
- Metals present in the surface water samples included antimony, arsenic, selenium, and thallium.

No groundwater samples were collected by TNRCC.



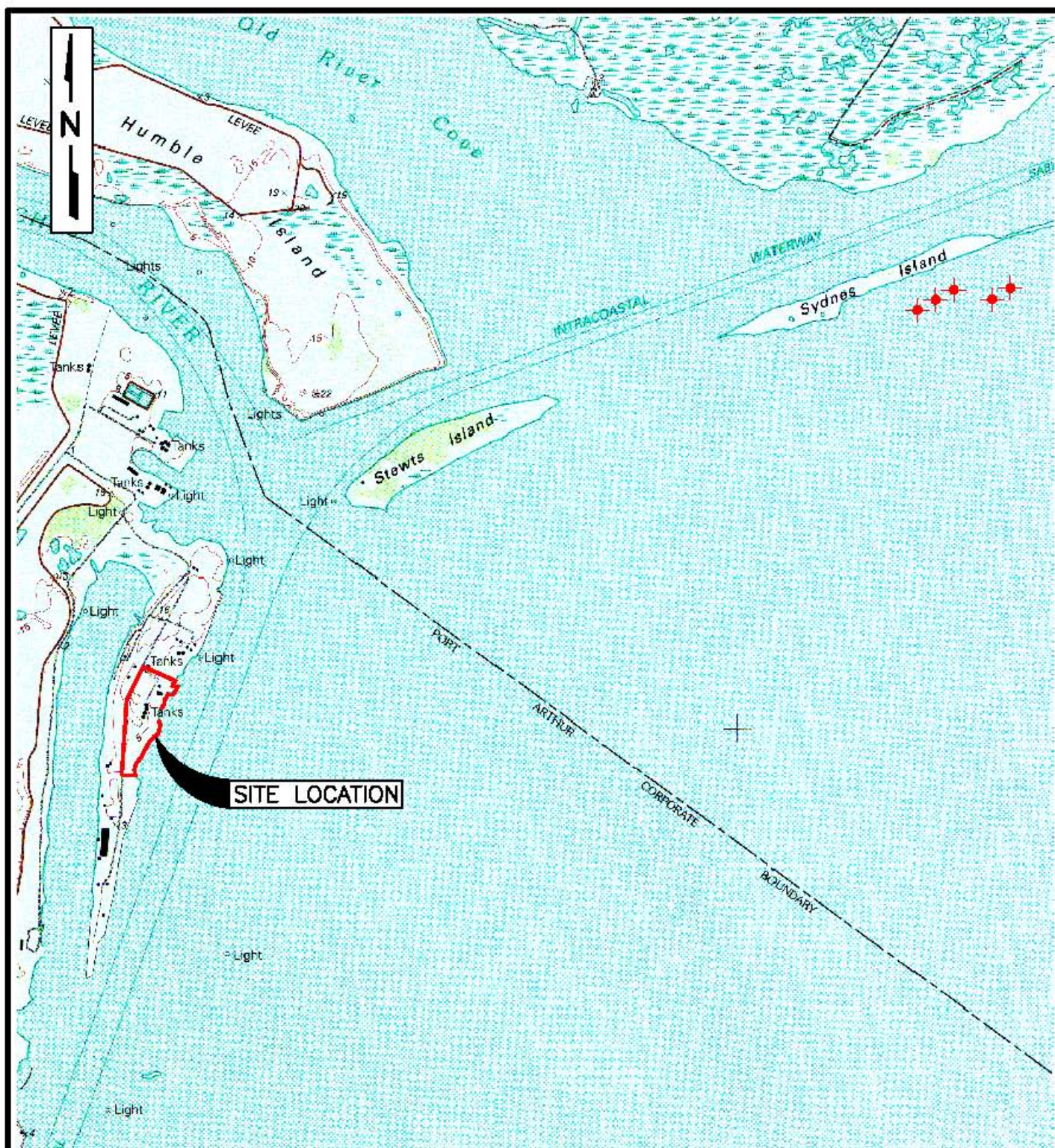
SOURCE:
RAND McNALLY, TEXAS STATE MAP 1997
8255 NORTH CENTRAL PARK AVENUE
SKOKIE, IL 60076.

0 10 20
SCALE IN MILES
(APPROXIMATE)


WESTON

FIGURE 2-1
STATE MARINE
SUPERFUND SITE
US EPA REGION 6
CERCLA ID NO. TXD099801102
SITE LOCATION MAP
REMEDIAL INVESTIGATION
FEASIBILITY STUDY
PORT ARTHUR, JEFFERSON COUNTY, TEXAS


DATE	PROJECT NO.	SCALE
JAN 01	20074515012	AS SHOWN



LEGEND:

 SEDIMENT SAMPLE LOCATION

SOURCE:
 US GEOLOGICAL SURVEY, PORT ARTHUR NORTH
 QUADRANGLE, 7.5 MINUTE SERIES (TOPOGRAPHIC),
 AND WEST OF GREENS BAYOU QUADRANGLE, TEXAS-
 LOUISIANA, 1993.

0 1000 2000

 SCALE IN FEET
 (APPROXIMATE)

CERCLA ID NO. TXD099801102

WESTON
ENGINEERS DESIGNERS/CONSULTANTS

FIGURE 2-2 STATE MARINE SUPERFUND SITE

US EPA REGION 6
 OFFSITE BACKGROUND
 SAMPLE LOCATION MAP
 REMEDIAL INVESTIGATION
 FEASIBILITY STUDY

PORT ARTHUR, JEFFERSON COUNTY, TEXAS

DATE JAN 01	PROJECT NO. 20074515012	SCALE AS SHOWN
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0 100 200 300 Feet

LEGEND

— STATE MARINE SUPERFUND SITE PROPERTY BOUNDARY

SOURCE: AERIAL VIEWPOINT
P.O. BOX 692075-294
HOUSTON, TX 77269

WESTON
MANAGERS DESIGNERS/CONSULTANTS

FIGURE 2-3

STATE MARINE SUPERFUND SITE
USEPA REGION 6

CERCLA ID NO. TXD099801102

SITE PLAN

REMEDIAL INVESTIGATION FEASIBILITY STUDY

PORT ARTHUR, JEFFERSON COUNTY,
TEXAS

DATE JAN 01	PROJECT NO. 20074.515.012.9989	SCALE AS SHOWN
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Table 2-1

Summary of Maximum SVOCs and Metals Identified in On-Site Soils
(CH2M Hill, 1999)

Constituent	Maximum Detected Concentration
SVOCs (mg/kg)	
2-Methylnaphthalene	0.7J
Acenaphthene	1.5
Acenaphthylene	2.9
Anthracene	3.4
Benzo(a)anthracene	3.3
Benzo(a)pyrene	3J
Benzo(b)fluoranthene	5.9
Benzo(k)fluoranthene	2.4
Carbazole	1.3
Chrysene	8.4
Dibenz(a,h)anthracene	0.49
Dibenzofuran	0.6
Di-n-octylphthalate	0.13J
Fluoranthene	7.9
Fluorene	1.2
Naphthalene	0.86
Pyrene	25
Bis(2-ethylhexyl)phthalate	1.9B
2,4-Dimethylphenol	0.02J
4-Methylphenol	0.042J
4-Nitroaniline	5.4J
Butylbenzylphthalate	0.4
Dimethylphthalate	0.031J
Di-n-butylphthalate	0.3J
N-Nitrosodiphenylamine	0.13J
Metals (mg/kg)	
Aluminum	14,100
Antimony	44.7
Arsenic	17.7
Barium	501
Beryllium	27
Cadmium	2.6
Calcium	167,000
Chromium	63.6
Cobalt	65.6
Copper	1,670
Iron	200,000
Lead	4,090
Magnesium	3,920
Manganese	11,320J
Mercury	0.76
Nickel	243

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Table 2-1 (Continued)**Summary of Maximum SVOCs and Metals Identified in On-Site Soils****(CH2M Hill, 1999)**

Constituent	Maximum Detected Concentration
Potassium	3,150
Selenium	4.5
Silver	0.95
Sodium	4,100J
Thallium	237J
Vanadium	45.3
Zinc	38,700
Cyanide	1.3

Notes:

1. SVOC –semivolatile organic compounds
2. mg/kg - milligrams per kilogram
3. J – constituent estimated
4. B – detected in laboratory blank

Table 2-2
Summary of Maximum SVOCs and Metals Identified in Sabine Lake Sediment
(CH2M Hill, 1999)

Constituent	Maximum Detection
SVOCs	
Acenaphthylene	0.58
Anthracene	2
Benzo(a)pyrene	2.3
Benzo(b)fluoranthene	3.6
Benzo(g,h,i)perylene	0.24
Benzo(k)fluoranthene	1.9
Bis(2-ethylhexyl)phthalate	0.26J
Butylbenzylphthalate	0.064J
Carbazole	0.31J
Chrysene	3.9
Dibenz(a)anthracene	0.23
Dibenzofuran	0.36J
Di-n-butylphthalate	0.096
Di-n-octylphthalate	0.22
Fluoranthene	9.1J
Fluorene	0.79
Indeno(1,2,3-cd)pyrene	0.34
Phenanthrene	7.1
Pyrene	8.8
Metals (mg/kg)	
Aluminum	6,380
Antimony	3.2
Arsenic	11.7
Barium	97
Beryllium	2.7
Cadmium	0.42U
Calcium	30,500
Chromium	20
Cobalt	13.3
Copper	312J
Iron	36,200
Lead	362
Magnesium	3,590
Manganese	745J
Mercury	0.21U
Nickel	26.4
Potassium	2,160
Selenium	1.2U
Silver	0.83U

Table 2-2 (Continued)**Summary of Maximum SVOCs and Metals Identified in Sabine Lake Sediment****(CH2M Hill, 1999)**

Constituent	Maximum Detection
Sodium	3,140J
Thallium	2.1
Vanadium	20.9
Zinc	3,910
Cyanide	1U

Notes:

1. SVOC – semivolatile organic compounds.
2. mg/kg - milligrams per kilogram.
3. J – constituent estimated.
4. U – not detected at instrument detection limit.

3. SCOPE OF WORK

The Scope of Work for the SMS RI/FS is divided into 12 tasks. The specific work that will be performed for each task are discussed in this section of the TWP. These tasks are designed to meet the objectives of the RI/FS, as established in Section 1. The RI/FS tasks described in the following subsections include the following:

- Task 1—Project Planning
- Task 2—Community Relations
- Task 3—Field Investigation
- Task 4—Sample Analysis and Data Validation
- Task 5—Data Evaluation
- Task 6—Risk Assessment
- Task 7—Treatability Studies
- Task 8—Remedial Investigation Report
- Task 9—Feasibility Study Process
- Task 10—RI/FS Report Preparation
- Task 11—Project Closeout
- Task 12—Project Management and Quality Assurance

3.1 TASK 1—PROJECT PLANNING

An overview of Task 1—Project Planning is summarized below:

Objectives: The objective of this task is to perform the effort necessary for project planning for the SMS RI/FS.

Activities to be Performed: The activities that will be performed as part of Task 1 include background research, site reconnaissance, attendance at a scoping meeting(s), preparation of a site-specific TWP, and subcontracting.

Data Sources: Information needed to complete this task will include available site background information and relevant EPA guidance documents.

Deliverables: WESTON will provide EPA Region 6 personnel with the documents described in the following subtasks.

3.1.1 Background Research

Upon receipt of authorization, WESTON began planning the specific activities to be conducted as part of the RI/FS. As part of this planning effort, WESTON complied and reviewed existing site background information. A site reconnaissance visit was conducted to examine current site conditions and review potential RI/FS sample locations with EPA Region 6 personnel for development of the baseline human health and ecological risk assessments as well as the site-specific SAP, QAPP, and HASP.

3.1.2 Scoping Meetings and Site Visits

Prior to submittal of the site-specific RI/FS TWP, WESTON met with EPA Region 6 personnel to discuss the following:

- The proposed scope of the project, the human health and ecological risk assessments, and specific investigative and analytical activities that will be required.
- Site access issues.
- The preliminary investigation objectives and general response actions.

3.1.3 Site-Specific Work Plan Preparation and Subcontracting

Once the site-specific scope of work was agreed upon with EPA Region 6 personnel, WESTON initiated the following:

- Site-specific project plans to meet the objectives of the RI/FS.
- Subcontractor procurement and coordination.

In performing this task, WESTON prepared this site-specific TWP. The TWP provides a project description outlining the overall technical approach of the RI/FS, and it includes the corresponding personnel requirements and activity schedules. After the technical scope of work was developed, subcontracting activities were initiated. A subcontractor will be required for monitoring well, boring advancement, and site surveying as well as the sediment sampling activities. In addition, a subcontracted laboratory will be used where appropriate for the

analytical services required outside of the EPA CLP laboratory for the soil, sediment, surface water, and groundwater samples collected during the investigation.

A discussion of the human health and ecological risk assessments is provided in Task 6. The human health and ecological risk assessment work plan is included as Appendix A. The purpose and general contents of the SAP, QAPP, and HASP are defined below and are presented in Appendices B, C, and D.

3.1.3.1 *Sampling and Analysis Plan (SAP) Preparation*

The SAP presents a description of the field sampling activities and the analytical approach that will be utilized during the SMS RI/FS. The SAP will provide the following information regarding sampling activities:

- A general overview of the State Marine Superfund Site.
- An explanation of what additional data are required to meet the RI/FS objectives.
- The RI/FS sampling objectives, sample locations, and sampling rationale.
- A description of the sample collection methods.
- Specification of the analyses to be performed on the samples.
- Quality assurance information and reference to the QAPP.
- Equipment decontamination procedures.
- Investigation-derived waste (IDW) management.

The SAP is presented in Appendix B. It should be noted that the sampling and analysis plan for the off-site investigation area of Lake Sabine is a stand-alone document and is presented in Appendix E.

3.1.3.2 *Quality Assurance Project Plan (QAPP) Preparation*

WESTON has prepared a QAPP that presents the general quality assurance guidelines to be followed during performance of the State Marine RI/FS field work and subsequent laboratory analyses. The QAPP includes the following:

- A project organization chart illustrating the lines of responsibility.

- Data quality objectives (DQOs) for analytical data, including the required degree of precision and accuracy, completeness of data, representativeness of data, comparability of data, and the intended use of collected data.
- Sample custody procedures to be employed during sample collection and during laboratory handling, and the required documentation to be included as part of the final evidence files.
- The type and frequency of calibration procedures for field and laboratory instruments, internal quality control checks, quality assurance performance audits, and system audits.
- Preventative maintenance procedures and schedule and corrective action procedures for field and laboratory instruments.
- Specific procedures to assess data precision, representativeness, comparability, accuracy, and completeness of specific measurement parameters.
- Data documentation and tracking procedures.

The QAPP is provided as Appendix C of this Work Plan. Specific QAPP requirements for the off-site investigation are included in the site sampling and analysis plan in Appendix E.

3.1.3.3 *Health and Safety Plan (HASP) Preparation*

WESTON anticipates updating and using the existing Palmer Barge Line HASP implemented for the completed removal activities at the Palmer Barge site. The HASP will be based on the results of previous investigations at this adjacent site and observations recorded during the Palmer Barge reconnaissance and removal activities. The purpose of the HASP is to protect personnel involved in site investigation activities and potential local residents from exposure to hazards associated with the investigation. The HASP will address applicable regulatory requirements contained in the following:

- 40 CFR 1910.120(i)(2)—Occupational Health and Safety Administration (OSHA), Hazardous Waste Operations and Emergency Response Standard, Interim Rule, December 19, 1986.
- EPA Order 1440.02—Health and Safety Requirements for Employees Engaged in Field Activities.
- EPA Order 1440.3 Respiratory Protection.

- EPA Occupational Health and Safety Manual.
- EPA Interim Standard Operating Procedures (September 1982).

The SMS HASP includes general site background information and conditions and specifies the personnel responsibilities, protective equipment, health and safety procedures and protocols, decontamination procedures, training, and the type and extent of medical surveillance necessary for protection from site conditions. The HASP identifies potential problems and hazards that may be encountered and explains how these will be addressed. Procedures for protecting third parties such as visitors and the surrounding community have also been provided.

The HASP is provided as Appendix D.

3.2 TASK 2—COMMUNITY RELATIONS

An overview of Task 2—Community Relations is summarized below:

Objectives: As determined necessary by EPA Region 6 personnel, WESTON will assist in community relations activities as necessary and directed.

Activities to be Performed: Based on the preliminary scope of work discussions by WESTON and EPA Region 6 personnel for the SMS RI/FS, community relations efforts will most likely be limited and minor.

Data Sources: Information needed to complete this task, if required, may include the deliverables listed in Task 1, any available community relations plans, available and relevant community information and access, and available and relevant EPA guidance documents on community interaction.

Deliverables: No deliverables have been identified for this task.

3.3 TASK 3—FIELD INVESTIGATION

An overview of Task 3—Field Investigation is presented below:

Objectives: The objectives of RI/FS field investigation are to conduct the necessary activities to characterize and evaluate the extent of contamination, to determine the actual or potential risks to human health and the environment posed by the SMS, and to develop remedial alternatives for identified site-related contamination.

Site investigation activities will follow the site-specific TWP and related plans developed in Task 1. Strict chain-of-custody procedures will be followed for all collected samples including contract laboratory procedures (CLP) and non-CLP samples. WESTON will provide management and quality control (QC) review of the activities conducted under this task.

Activities to be Performed: Based on scoping discussions between WESTON and EPA Region 6 personnel, WESTON understands that the field activities required for the SMS RI/FS include sampling of on-site soil and groundwater and off-site sediments from Sabine Lake. Sampling will be performed across the site in an effort to determine the area and extent of soil contamination associated with the identified source areas. This information will be used to evaluate potential remedial alternatives for the site. Management of IDWs and surveying of sample locations will also be performed during the RI/FS. A brief description of these activities is described as follows:

- **On-Site Investigation**—WESTON will procure a subcontractor to provide drilling services for completion of shallow soil borings. In addition, four shallow soil borings will be converted into groundwater monitoring wells depending on subsurface materials encountered during the investigation. Soil and groundwater samples will be collected from identified on-site waste source areas including the former wastewater impoundments, wastewater treatment facility, current storage tank area, maintenance shed, tar burn area, and the former Lauren Refining Company tank farm. Samples collected during the field investigation will either be submitted to an EPA-designated CLP laboratory for select organic and inorganic analyses or to a non-CLP laboratory for analyses outside of the normal CLP Statement of Work (SOW). Refer to the QAPP for a complete listing of suggested organic and inorganic analyses including Project Required Quantitation Limits (PRQLs). Additionally, WESTON may submit a limited number of high concentration (waste) soil and groundwater samples (based on the results of field screening data and visual inspection of samples during field activities) to EPA's Houston, Texas, laboratory.
- **Off-Site Investigation**—WESTON will procure a subcontractor to provide off-site sampling services including a sampling vessel and sampling equipment from which surface and subsurface sediment samples can be collected. All collected sediment

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samples will be submitted to either the EPA's Houston, Texas, laboratory or a non-CLP laboratory as necessary for analyses. Refer to the Sampling and Analysis Plan for the Off-Site Investigation Area (Appendix E) for a complete listing of suggested organic and inorganic analyses including Project Required Quantitation Limits (PRQLs)

- IDW Management—WESTON will generate IDWs including soil cuttings from drilling operations, decontamination wastewater, and spent personal protective equipment (PPE) as part of the RI/FS. WESTON will manage these IDWs in general accordance with the protocols described in the SAP and HASP, generally by drumming these wastes and staging them on-site. The IDW drums generated during the RI/FS may require off-site disposal by a qualified waste disposal firm at the end of the field activities. The disposal firm and the disposal location will depend on the classification of the wastes that will be sampled during the RI/FS. Because the nature and volume of these wastes is not yet known, off-site disposal of the IDWs is not included as a task in this Scope of Work.
- Surveying of Sample Locations—WESTON will survey the locations where samples are collected during the RI/FS field activities using Global Positioning System (GPS) technology. The GPS unit will obtain horizontal control of the on-site soil samples and off-site sediment samples collected during the investigation. WESTON will also procure a subcontractor to survey the soil borings and groundwater monitoring well locations as needed and any other relevant locations for mapping purposes. The surveyor will obtain horizontal and vertical control of all monitor well locations. At the end of the RI/FS, the GPS and survey data will be incorporated into the SMS database for inclusion into the RI/FS report.

Data Sources: Information required to complete this task will be obtained from this TWP, field observations, and EPA non-CLP and CLP guidance documents.

Deliverables: Information from the field investigation will be summarized and included in the RI/FS report. WESTON will also prepare and submit to EPA Region 6 personnel, if requested, a progress report after completion of the field investigation portion of the RI/FS. The progress report will include but is not limited to the following:

- An outline of the field work completion schedule.
- Documentation of field activities including a copy of field logbooks and an outline of deviations from the approved project plans.
- Digital photographs of the RI/FS field activities for inclusion in daily reports or pollution reports (POLREPs).

- Summary of sample analytical results.

A listing of personnel involved in the field activities.

3.4 TASK 4—SAMPLE ANALYSIS AND DATA VALIDATION

An overview of Task 4—Sample Analysis and Data Validation is presented below:

Objectives: The objectives of this task are to quantitatively analyze the samples collected during the RI/FS and to validate the results generated by the analytical laboratories.

Activities to be Performed: The samples collected during the RI/FS will be sent to either EPA-designated CLP laboratories or non CLP laboratories for analysis. High concentration samples, if collected, may be submitted to the EPA Houston, Texas, laboratory for analyses. If analytical testing is not available there, then a subcontract laboratory will be provided for analytical testing. A standard 35-day (25 working days) turnaround will be requested from the laboratories.

EPA Regional Sample Coordination Center (RSCC) personnel in EPA Region 6 will perform validation of the CLP data obtained from the CLP laboratories. WESTON personnel will validate all non-CLP data. Data will be validated at the required field or laboratory QC level to determine whether it is appropriate for its intended use. WESTON will incorporate all sample results and validation comments into the RI/FS report.

As part of this task, WESTON will utilize a standard data management system that includes the use of bound field logbooks, sample management and tracking procedures, and document control and inventory procedures for both laboratory data and field measurements.

Data Sources: Information needed to complete this task will be obtained from the TWP, field observations, EPA CLP laboratory data, and the EPA Region 6 quality assurance/quality control (QA/QC) office.

Deliverables: The CLP Form for each sample analysis and the data validation memoranda prepared by the RSCC data validators will be reviewed and included as an RI/FS report appendix.

3.5 TASK 5—DATA EVALUATION

An overview of Task 5—Data Evaluation is summarized below:

Objectives: The objectives of this task are for WESTON to evaluate the data obtained from non-CLP laboratories and to present the results of this laboratory analyses in an organized and logical manner.

Activities to be Performed: WESTON will perform the following:

- The quantities and concentrations of specific chemicals detected in the RI/FS samples will be tabulated.
- The analytical results will be evaluated and a determination made for data usability.
- The number, locations, and types of nearby populations and activities will be surveyed.

Data Sources: Information needed to complete this task will be obtained from the TWP, field observations, and the validated analytical data obtained for the RI/FS samples.

Deliverables: Sample data will be evaluated, tabulated, and incorporated into the appendices of the RI/FS.

3.6 TASK 6—RISK ASSESSMENT

An overview of Task 6—Risk Assessment is summarized below:

Objectives: In conjunction with the RI/FS field activities, a baseline human health risk assessment and an ecological screening risk assessment will be completed. The purpose of this task is to identify a preliminary list of chemicals of potential concern (COPCs) and to present the major assumptions and approaches to be used in the risk assessments for the site. The risk assessments serve to identify and estimate the potential human health and ecological risks associated with chemical contamination at a site, and are used for the purposes of determining the necessity and extent of remediation.

Activities to be Performed: The development of a site-specific human health and ecological risk assessment work plan that focuses on completing a summary of background information, summary of existing data, human health and ecological preliminary screening evaluations, and human health and ecological risk assessments.

Data Sources: Information needed to complete this task will be obtained from the TWP, field observations, and RI/FS field investigation data.

Deliverables: The results of the human health baseline risk assessment and the ecological screening risk assessment will be presented as part of the RI/FS report.

The SMS risk assessment work plan is included in Appendix A.

3.7 TASK 7—TREATABILITY STUDIES

Objectives: The objectives of this task are to evaluate treatability studies as necessary to obtain additional data for use in the feasibility study. Then purposes of the treatability studies are to establish site-specific performance data, and determine if there are other issues about the water/soil chemistry that could negatively impact performance of the remedy or result in costs that are significantly different than those specified in the document.

Activities to be Performed: WESTON with the concurrence of the EPA shall conduct bench and/or pilot studies as necessary to determine the suitability of remedial technologies to site conditions and problems. Technologies that may be suitable to the site include laboratory data including titration curves for neutralization of groundwater, centrifuge data for solids handling, belt press for solids handling and chemical analyses of groundwater. Laboratory treatability studies may include gaseous absorption on vapor-phase activated carbon, liquid adsorption on granular activated carbon, oil/water separator for potentially recovered oils, soil heating, UV oxidation, low temperature stripping, and high temperature thermal treatment. Pilot studies may include soil washing and vitrification.

Data Sources: Should treatability studies be determined to be necessary, a testing plan identifying the types and goals of the studies, the level of effort needed, a schedule for

completion, and the data management guidelines shall be prepared and submitted to EPA for review and approval.

Deliverables: Upon completion of the testing, WESTON will evaluate the results to assess the technologies with respect to the goals identified in the test plan. A report summarizing the testing program and its results shall be prepared and presented in the final RI/FS report.

3.8 TASK 8—REMEDIAL INVESTIGATION REPORT

An overview of Task 8—Remedial Investigation Report is presented below:

Objectives: The objectives of this task are to prepare a report presenting the results of the RI.

Activities to be Performed: WESTON, at the request of the EPA Work Assignment Manager (WAM), will prepare and submit a draft RI report to EPA Region 6 personnel for review. Once comments on the draft RI report are received, WESTON will prepare a final RI report reflecting these comments.

Data Sources: Information needed to complete this task will be obtained from the RI/FS field investigation activities.

Deliverables: WESTON will prepare and submit a final RI report to EPA Region 6.

3.9 TASK 9—FEASIBILITY STUDY PROCESS

Objective: The objective of Task 9 is to develop a range of distinct, hazardous waste management alternatives that may be used to remediate or control potential site-related contamination remaining at the site and to provide adequate protection of human health and the environment. Objectives of the feasibility study (FS) include the following:

- Reduce the risk of exposure to any residual contaminated media to levels that protect human health and the environment.
- Achieve sitewide compliance with applicable environmental regulations. This requires an evaluation of Applicable or Relevant and Appropriate Requirements (ARARs).

- Reduce contaminated media to appropriate risk-based levels, and minimize or eliminate, if possible, off-site migration of contaminants in the soil and groundwater by groundwater transport, surface water runoff, or air pathways.
- Achieve highest degree of cost effectiveness.
- Maintain the estimated risk of exposure from any affected air emissions or surface water runoff generated by the remedial action to levels that are protective of human health.
- Use technologies that have been demonstrated to be effective and to minimize operation requirements.

Activities to be Performed: The SMS FS will be consistent with Section 30 of the *Texas Administrative Code* (TAC), Chapter 335.348, Subchapter K (Hazardous Substances Facilities Assessment and Remediation) and the two following TNRCC guidance documents: *Presumptive Remedies for Soils at State Superfund Sites* (RG-277, April 1997) and *Presumptive Remedies for Groundwater at Texas Superfund Sites* (RG-337, January 1999). Where appropriate, reference may be made to the *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA*, (EPA/540/G-89/004). The specific steps that will be completed as part of the FS process as outlined in the TNRCC documents are described in the following subsections.

3.9.1 Step 1—Data Collection and Compilation

WESTON will review available data for the SMS. Input to the FS will also include the RI investigation results and the baseline risk assessment (which will include a detailed review of ARARs).

Site-specific information will include both site geology/hydrogeology and groundwater information; geochemical processes include oxidation/reduction, sorption/desorption, ion exchange, and complexation. Specific information regarding the level and extent of contamination in the groundwater, any trends in chemical concentrations in the groundwater, and general water-bearing zone characteristics will be collected to apply the presumptive process to potentially impacted groundwater at the site. The potential for off-site migration and discharge to Sabine Lake will also be evaluated.

Supplemental data that will be obtained during the RI may include physical features (bottom slope, water depths, location of piers or submerged structures), hydrodynamic conditions (water column currents, long-term bottom currents, storm surge conditions, tidal conditions), hydrogeologic conditions (groundwater-surface water interactions), water usages (navigation, recreation, flood control, waterfront development, and sensitive aquatic habitats), and biological communities (presence of burrowing organisms).

As part of Step 1, all data will be compiled and extensively reviewed to identify data gaps that could potentially impact the FS. If needed, these data gaps will be addressed by collection of additional information during a supplemental investigation.

3.9.2 Step 2—Determination Of Cleanup Goals

Cleanup goals for contaminated media at the site will be established as part of the baseline risk assessment. It should be noted that cleanup goals cannot be finalized until remedial objectives are established, but will likely include the following:

- Health-based Criteria.
- Chemical Specific ARARs such as the Resource Conservation and Recovery Act (RCRA), Safe Drinking Water Act (SDWA), Clean Water Act (CWA), Clean Air Act (CAA), and maximum contaminant levels (MCLs).
- Location-specific ARARs (state and local regulations).
- Action-specific ARARs.

3.9.3 Step 3—Identification Of Predominant Chemical Group

Once all of the chemicals or chemical groups that exceed (or potentially exceed) cleanup goals for particular media (soil, groundwater, sediment) have been identified, the predominant chemical group is then selected. The predominant chemical group is the group of chemicals that would be expected to have the greatest influence on remedy selection for site soil, groundwater, and sediment.

In general, the predominant chemical group will likely be one that will be the most difficult to remediate or that requires the most rigorous remediation, either to low levels required or the recalcitrant nature of the chemical.

3.9.4 Step 4—Identification Of Presumptive Remedy For Consideration

Once the predominant chemical group has been identified, the Presumptive Remedies Guidance Documents will outline the technologies that should be considered. The sections within these documents describe the technologies that will be considered for contaminated media affected by each chemical group and the approaches to remedy the site. Flow diagrams outline each predominant chemical group based on an evaluation of the potential approaches to site cleanup. These flow diagrams, along with the site-specific information, will be used to identify the presumptive remedy for consideration.

Once a presumptive remedy has been identified for consideration to address the predominant chemical group, an evaluation will be made to determine whether the presumed remedy is consistent with presumptive remedies for other chemical groups at SMS. Once the remedies for each group have been identified, an evaluation will be made as to whether they should be implemented separately or whether a common, effective remedy could be selected, and in what order the treatment should be applied.

3.9.5 Step 5—Determination If Existing Information Is Adequate To Support Remedy Identification

Step 5 will determine if the existing information is adequate to support the identified remedy or remedies. The presumptive remedy process is based on general site descriptions and a number of assumptions. As part of this step, the actual conditions at the SMS will be compared to the assumptions used in the development of the document and to verify that they are adequately similar. If needed, a sensitivity study will be performed based on assumptions used to determine if variations in the assumed condition within the range anticipated for the site would change the remedy selected (i.e. volume of soil or groundwater, pumping rate, concentrations of chemicals present, etc.).

If the selected presumptive remedy would not change with variations in the assumption made, information is not required for final remedy selection and the presumptive remedy process will continue to Step 7. If variations in the assumptions could potentially change the remedy selected, Step 6 will be performed.

3.9.6 Step 6—Collect Additional Information

Step 6 is included if additional information is needed to finalize the remedy selection process. The types of information that may be collected as appropriate include the following:

- Better definition of level and extent of contamination.
- Aquifer testing to verify pumping rates and/or flow rates.
- Sampling to investigate the specific chemicals present and their concentrations in media.
- The presence of constituents that could impact technology application.
- The results of treatability studies.

3.9.7 Step 7—Report Preparation

On the completion of the steps described above, a draft Presumptive Remedies Document will be prepared. The report shall include the following information:

- A summary of the results of the RI activities, particularly those influencing the identification of a presumptive remedy.
- Documentation of the presumptive remedies/feasibility study process and factors that were considered when applying the logic flow diagrams.
- Justification for identification of a remedy other than the preferred remedy for a particular chemical group.
- The results of the treatability testing, if preformed, to support the identified remedy.
- Additional information, if any, that would be needed to move forward with Remedial Design/Remedial Action (RD/RA) for the identified remedy.

3.10 TASK 10—RI/FS REPORT PREPARATION

An overview of Task 10—RI/FS Report preparation is presented below:

Objectives: The objectives of this task are to prepare a report presenting the results of the RI/FS.

Activities to be Performed: WESTON will prepare and submit a draft RI/FS Report to EPA Region 6 personnel for review. Once comments on the draft RI/FS Report are received, WESTON will prepare a final RI/FS Report reflecting these comments.

Data Sources: Information needed to complete this task will be obtained from the RI/FS field investigation activities, the presumptive remedies document, and the results of the baseline risk assessment.

Deliverables: WESTON will prepare and submit a final RI/FS Report to EPA Region 6 as part of this task.

3.11 TASK 11—PROJECT CLOSEOUT

An overview of Task 11—Project Closeout is described below:

Objective: The objective of this task is to document the closeout (Tasks 1 – 10) of the SMS RI/FS project.

Activities to be Performed: WESTON will prepare a project closeout report when directed by EPA Region 6 personnel.

Data Sources: Information needed to close out the project will be obtained from WESTON's project management system and EPA Region 6 personnel.

Deliverables: WESTON will prepare and submit a project closeout report and send administrative record files to the EPA when requested.

3.12 TASK 12—PROJECT MANAGEMENT AND QUALITY ASSURANCE

An overview of Task 12—Project Management and Quality Assurance is presented below:

Objectives: The objective of this task is to maintain the project at a properly managed level, to ensure that the quality of the work performed meets the goals and objectives set forth by the EPA, and to ensure that EPA Region 6 personnel are informed about the progress of the project.

Activities to be Performed: WESTON will manage the project and perform QA on all activities throughout the duration of the project. Meetings, conference calls, and progress reports will be completed to keep EPA Region 6 personnel informed of project activities.

Telephone conference calls will be held as necessary:

- Weekly during major site activities.
- As needed to keep the EPA Region 6 personnel informed regarding progress being made.

Meetings will be held as necessary:

- Scoping meetings will be held, as described in Subsection 3.1.2.
- Monthly meetings will be held during major site activities, as requested by the WAM.

If requested, monthly progress reports will be prepared and submitted to EPA Region 6 personnel. Monthly reports will be prepared, if requested, by WESTON personnel to describe the technical and financial progress of the project. Each month, WESTON at the request of EPA Region 6 personnel, will report the following items:

- Status of work and the progress to date for each task.
- Percentage of the work completed and the status of the schedule for each task.
- Difficulties encountered and corrective actions to be taken.
- The activity(ies) in progress.
- Activities planned for the next reporting period.

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- Any changes in key project personnel.
- Actual expenditures (including fee) and direct labor hours for the reporting period and for the cumulative term of the project for each task and subtask.
- Projection of expenditures needed to complete the project and an explanation of significant departures from the original budget estimate for each task and subtask.

Deliverables: WESTON will provide, if requested by EPA Region 6 personnel, monthly progress reports. WESTON also anticipates submitting minutes of meetings and telephone conference calls to EPA.

Data Sources: Information needed for project management performance includes WESTON's project management system, WESTON deliverables, the Quality Assurance Project Plan, and periodic reports from project personnel to WESTON's Site Manager.

4. QUALITY ASSURANCE

WESTON will perform the work associated with the RI/FS in general accordance with the Quality Assurance Project Plan presented in Appendix C. The specific procedures that will be used for document submittal by WESTON to EPA include a minimum of two reviews by WESTON personnel other than the primary author on the deliverables indicated in this TWP. This review will be conducted by a Technical Quality Assurance Manager for technical accuracy and by a senior project person familiar with the aspects of the project.

5. PROJECT INFORMATION

This section outlines basic project management information for the SMS RI/FS. Details concerning key personnel and the project schedule are provided.

5.1 KEY PROJECT PERSONNEL

Anticipated project personnel who will be performing field activities for this RI/FS are shown on Table 5-1. The key project personnel for this RI/FS are shown on Figure 5-1.

5.2 PROJECT SCHEDULE

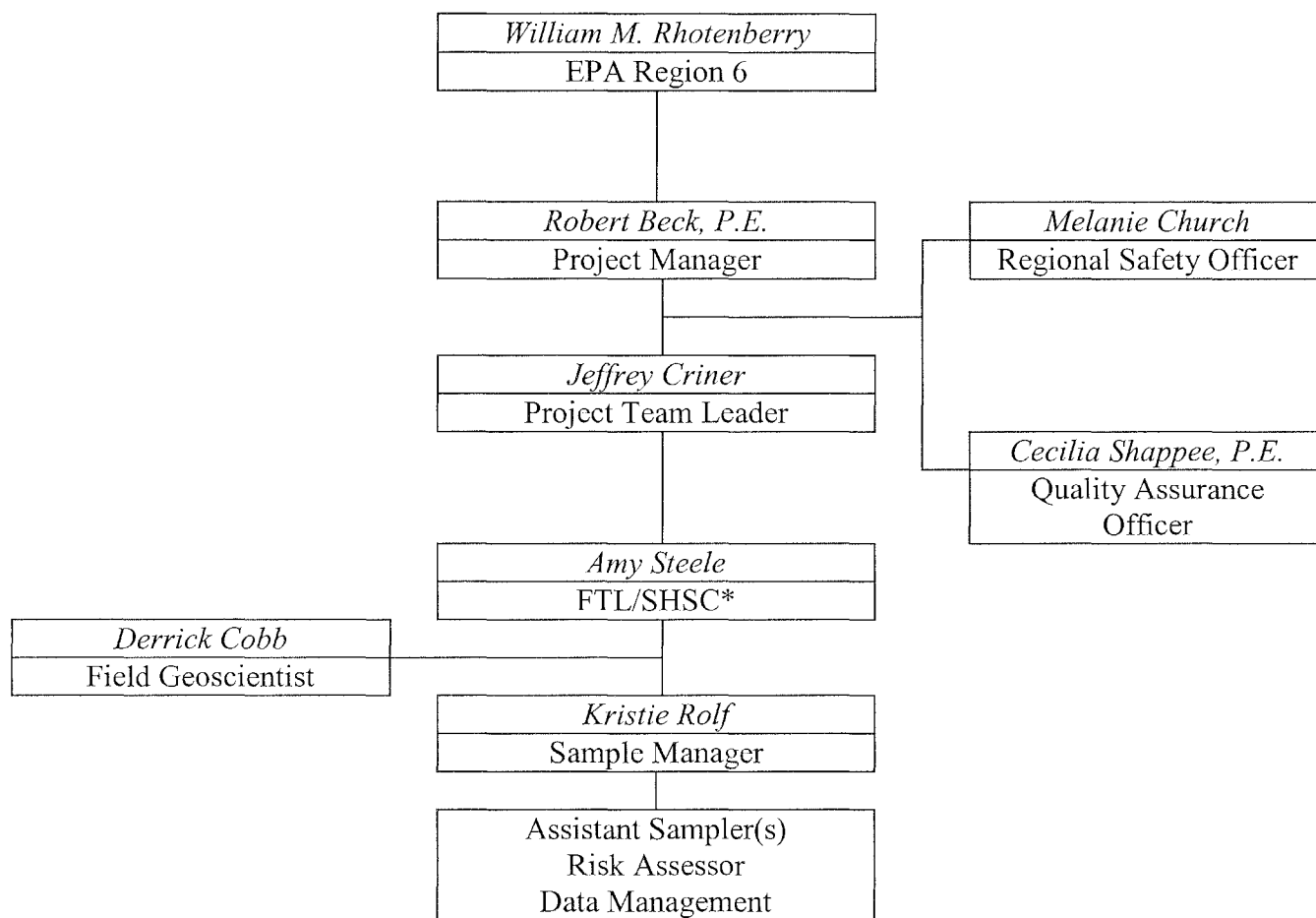
The overall project schedule is summarized in Table 5-2.

5.3 IMPORTANT TELEPHONE NUMBERS

Important telephone numbers that may be needed include the following:

- Local Hospital: St. Mary's Hospital—(409) 985-7431
- WESTON 24-hr Emergency: (800) 229-3674
- WESTON Houston Office: (713) 985-6600
- WESTON Austin Office: (512) 651-7100
- WESTON San Antonio Office (210) 342-7810
- WESTON RES: (713) 796-0040
- Federal Express (National): (800) 238-5355

Figure 5-1
Anticipated Key Project Personnel



Notes:

FTL = Field Team Leader

SHSC = Site Health and Safety Coordinator

Table 5-1
Anticipated Project Personnel

Name	Title	Roles	Project Responsibilities
Jeff Criner	Section Manager	Project Team Leader	Overall implementation of RI/FS Work Plan Staff Scheduling EPA Liaison.
Amy Steele	Senior Geoscientist	Field Team Leader/SHSC	Implementation of HASP in the field. Collection of samples. Implementation of the TWP in the field and final sample location selection. Project Field Coordinator.
Melanie Church	Safety Manager	Regional Safety Officer	Implementation of HASP.
Derrick Cobb	Geoscientist	Field Geoscientist/Asst. Field Team Leader	Air monitoring/monitoring equipment calibration. Collection of samples. Supervision of Gcoprobe activities. Equipment management and decontamination. Mobilization/Demobilization.
Kristie Rolf	Graduate Engineer	Sample Manager	Sample management. Sample documentation, packaging, and shipping. Collection of samples. Equipment management and decontamination. Mobilization/Demobilization.
Bruce Stirling	Senior Scientist	Risk Assessment	Overall implementation of human health and ecological risk assessment.

Notes:

SHSC = Site Health and Safety Coordinator

Additional field samplers and data management personnel may assist on this project.

PROJECT INFORMATION

Table 5-2

Project Schedule (2001 - 2002)

Target Milestones	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN
Site Reconnaissance	■								
Scoping Meeting with EPA		■	■						
Work Plan Preparation			■	■					
Work Plan Submittal to EPA			■						
Work Plan Review/Approval by EPA				■					
Field Sampling Visit				■	■				
Data Analysis by Laboratory						■			
Data Validation							■		
Report Writing								■	
Report Submission to EPA									■

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APPENDIX A

RISK ASSESSMENT WORK PLAN

SIGNATURE PAGE

William M. Rhotenberry
EPA Region 6
Site Assessment Manager

Date

Robert B. Beck, P.E.
Roy F. Weston, Inc.
Project Manager

Date

Andrew S. Kallus
Roy F. Weston, Inc.
Project Team Leader

Date

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LIST OF ACRONYMS

a.k.a.	Also known as
AET	Apparent Effects Threshold
ASTs	aboveground storage tanks
AWQC	Ambient Water Quality Criteria
BAF	bioaccumulation factor
BCF	bioconcentration factor
bgs	below ground surface
BHHRA	Baseline Human Health Risk Assessment
BSAF	biota-to-sediment accumulation factor (BSAF)
CLP	Contract Laboratory Program
COPC	chemical of potential concern
CRQL	Contract Required Quantitation Limit
CSF	Cancer Slope Factor
CT	Central Tendency
EPA	U.S. Environmental Protection Agency
ERA	Ecological Risk Assessment
ESI	Expanded Site Inspection
FCAA	Federal Clean Air Act
FS	Feasibility Study
g.i.	gastrointestinal
HEAST	Health Effects Assessment Summary Tables
HI	Hazard Index

LIST OF ACRONYMS (Continued)

HQ	Hazard Quotient
IRIS	Integrated Risk Information System
LOAEL	lowest observed adverse effects level
LRC	Lauren Refining Company
NOAA	National Organic and Atmospheric Administration
NOAEL	no observed adverse effects level
ORNL	Oak Ridge National Laboratory
PAH	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyl
PCL	protective concentration level
PEF	particulate emission factor
PRG	Preliminary Remediation Goal
QA	quality assurance
QC	quality control
RAGS	Risk Assessment Guidance for Superfund
RfC	reference concentration
RfD	reference dose
RME	reasonable maximum exposure
RRS2	Risk Reduction Standard 2
SBV	screening benchmark value
SCS	Soil Conservation Service
TRRP	Texas Risk Reduction Program

LIST OF ACRONYMS (Continued)

SVOC	semivolatile organic compounds
TAC	<i>Texas Administrative Code</i>
TAL	Target Analyte List
TBT	tributyltin
TCL	Target Compound List
TDS	total dissolved solid
TDWR	Texas Department of Water Resources
TNRCC	Texas Natural Resource Conservation Commission
TWQS	Texas Water Quality Standards
UCL	upper confidence limit
USACE	United States Army Corp of Engineers
USDA	United States Department of Agriculture
VOCs	Volatile organic compounds

1. INTRODUCTION

Roy F. Weston, Inc. (WESTON®) was contracted by the U.S. Environmental Protection Agency (EPA) Region 6 to develop a risk assessment work plan for the State Marine Superfund Site (SMS Site) located in Port Arthur, Jefferson County, Texas. The risk assessment will serve to identify and estimate the potential human health and ecological risks associated with chemical contamination at the SMS Site as well as determine the necessity and extent of remediation. The work plan for the risk assessment is presented here as Appendix A to the RI/FS Task Work Plan (TWP).

1.1 OBJECTIVES

WESTON is providing technical assistance to EPA Region 6 for the performance of the human health and ecological risk assessments for the SMS Site. The objectives of the risk assessment are to identify potential human health and ecological impacts associated with historical contamination at the SMS Site. The objectives will be achieved by evaluating data obtained during the field investigation and presenting the risk-based evaluation of that data in a human health and ecological risk assessment report to EPA Region 6.

Prior to the development of the SMS risk assessment work plan, WESTON submitted a Draft Risk Assessment Work Plan for the Palmer Barge Line Site (WESTON, 2000). Palmer Barge is also located in Port Arthur, Jefferson County, Texas and is directly adjacent to State Marine. Because State Marine and Palmer Barge are located directly adjacent to each other, they have the following common elements:

- Operations (barge cleaning was performed on both sites).
- Site owner (Mr. Chester Slay).
- Site contamination.
- Environmental setting, pathways of exposure, and receptors.

The Palmer Barge Work Plan was never implemented because of a change in scope that moved funding to the SMS RI/FS through the U.S. Army Corps of Engineers Rapid Response Contract (Contract No. DACA45-98-D0004). The Palmer Barge Work Plan identified a preliminary list of contaminants of potential concern (COPC) and presented the major assumptions and approaches to be used in the baseline human health and ecological risk assessments for that site. Since the pathways of exposure and receptors are primarily the same for both Palmer Barge and State Marine, much of the information regarding the approaches for State Marine were taken directly from the Draft Palmer Barge Risk Assessment Work Plan (WESTON, 2000).

Because of limitations in funding, the ecological portion of the risk assessment will be split into two phases of work. The first phase (Phase 1) will be limited to a screening-level risk assessment and the second phase (Phase 2), if implemented, will be a baseline risk assessment. The results of the screening-level risk assessment will indicate the need for completion of a baseline ecological risk assessment. The tasks associated with a second phase of ecological work may involve completing a baseline risk assessment work plan including a site-specific problem formulation, and a scope of work for additional field work including a SAP and QAPP. Completion of a baseline risk assessment, including the work plan and any associated tasks, will be addressed in Phase 2.

Discussion of previous investigations at the SMS Site by TNRCC (1996), CH2MHill (1999) and WESTON (2000) have been summarized in this work plan. Site-specific background information related to site location and description, site ownership, operational history, and environmental setting is presented in Section 2 of the RI/FS TWP.

1.2 REPORT FORMAT

The risk assessment work plan report organization is as follows:

- Section 1—Introduction
- Section 2—Data Evaluation
- Section 3—Human Health Risk Assessment

- Section 4—Ecological Risk Assessment
- Section 5—Data Gaps
- Section 6—List of References

All figures, tables, and excerpts presented in this report are included at the end of each respective section.

2. DATA EVALUATION

The objectives of the risk assessment data evaluation are to review and summarize the analytical data for each medium sampled to date at the SMS Site, to select the media that will be evaluated in the RI/FS field work, and to identify the contaminant groups to be sampled for each applicable medium. Chemical analyses will be limited primarily to SVOCs and metals in both the off-site and on-site investigation areas based on evaluation of historical data and discussions with EPA Region 6 and NOAA Coastal Resource staff at the 25 June 2001 meeting in Dallas, Texas. Because groundwater has not been previously sampled at the SMS Site, the full-suite of TCL organics (including VOCs and pesticides/PCBs) and TAL inorganics (including TBT) will be sampled at all groundwater monitoring well locations.

2.1.1 Summary of Historical Data

Preliminary remediation goals (PRGs) referenced in the discussions regarding the summary of historical data were developed by CH2MHill (1999). CH2MHill identified contaminant-specific PRGs by considering toxicity-based values for both human health and ecological receptors. PRGs were not developed using background concentrations because a background evaluation was not conducted as part of the CH2MHill scope of work.

Soil PRGs, for protection of human health, were developed for residential and industrial exposure scenarios using TNRCC Risk Reduction Standard 2 (RRS2) factors. CH2MHill also calculated soil PRGs in accordance with EPA Risk Assessment Guidance for Superfund (RAGS) Part B guidance (EPA, 1991a). By default, soil PRGs were used as surrogates for sediment to be protective of human health. Texas water quality standards (TWQS) (Figure: 30 *Texas Administrative Code* [TAC] §307.6[c][1]) and federal ambient water quality criteria (AWQC) (EPA, 1998a) were used as PRGs for surface water.

The development of PRGs for ecological receptors was based on established literature toxicity values for direct contact of compounds in media. For surface water, AWQC and TWQS for the protection of aquatic organisms were used as PRGs. For sediment, PRGs for the protection of

sediment dwelling organisms were based on EPA Ecotoxicity Thresholds (EPA, 1995), Long's Effects Range Low Values (Long, et.al, 1995), Ontario Ministry of the Environment (OMOE, 1993), and NOAA Screening Quick Reference (SQuiRT) Tables (Buchman, 1999). For soil, PRGs for the protection of plants and soil invertebrates were obtained from Oak Ridge National Laboratory (ORNL, 1996).

2.1.2 Results

The most detailed sampling effort performed at the SMS Site occurred in 1995 as part of the Expanded Site Inspection (ESI) conducted by TNRCC in support of a Hazardous Ranking System Documentation Report (TNRCC, 1996, 1997). Figures depicting TNRCC ESI sample locations are provided in Excerpt 1 (Figure 3-1 CH2Mhill, 1999).

The 1995 TNRCC sampling event included collection of soil, sediment, and surface water samples by TNRCC personnel. The samples were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides and polychlorinated biphenyls (PCBs), metals, and cyanide. Sampling for tributyltin (TBT) was not performed. TBT is an antifouling paint additive frequently used in barge cleaning operations and is a suspected contaminant at the SMS Site. Sediment and surface water samples were also taken by the TNRCC in 1995 in Sabine Lake to assess background conditions.

Details for each media sampled are provided below. Information presented was taken from the CH2MHill State Marine Superfund Site Technical Memorandum (CH2MHill, 1999).

2.1.2.1 Soil

Thirty surficial soil samples, including duplicates, were obtained from the Site in both on-site and off-site areas. Nineteen of 27 samples were obtained from areas of visible contamination, including the Lauren Refining Company (LRC) tank farm, the buried surface impoundments, the current and former aboveground storage tank area, and an area of discarded blasting sands. Three additional samples were obtained from off-site areas to assess background conditions. All the samples were collected from approximately 2 to 6 inches below ground surface (bgs).

Organics

VOCs were detected infrequently and at relatively low levels in several samples taken from the SMS Site. None of the VOCs detected exceeded their respective PRGs. Two of the detected VOCs, acetone and methylene chloride, are potential laboratory contaminants and may not be site related. SVOCs consisting of polynuclear aromatic hydrocarbons (PAHs) were encountered in all the samples except two. Elevated levels of PAHs were reported in at least one sample from each of the waste management areas identified. The list of PAHs detected includes several carcinogenic PAHs: benzo(a)pyrene, benzo(a)anthracene, benzo(a)fluoranthene, benzo(b)fluoranthene, and benzo(k)fluoranthene. PRGs were exceeded in at least two PAH samples from each waste area. Additional exceedances are likely because the laboratory quantitation limit for most SVOCs was greater than the respective PRG. Pesticides and PCBs were detected sporadically across the entire site. At least one sample from each waste management area contained pesticides and/or PCBs that exceed applicable PRGs.

Metals

Metals were identified in all the samples collected, and all samples contained at least three metals that exceeded the applicable PRG. Elevated levels of aluminum, chromium, copper, iron, lead, and zinc were encountered across the entire site and in the off-site areas. Several metals, including antimony, arsenic, mercury, selenium, and thallium were reported below laboratory quantitation limits. The reported quantitation limits for several samples were also above the respective PRGs.

Distribution of Contaminants

Excerpt 2 (Figure 3-2 CH2MHill, 1999), illustrates the distribution of organic compounds that exceeded PRGs in soil. Organic compounds consisting of PAHs and pesticides and PCBs are found in soils throughout the site based on biased sampling around known waste areas and/or visibly contaminated areas. Elevated levels of PAHs are typically found in areas where

petroleum products were stored or managed. Several metals were encountered above the PRGs in all soil samples but are not shown on this Figure. The highest concentrations of metals occurred in only three on-site samples (SO-13, SO-15, SO-16), each collected near or within the blasting sands area. This occurrence suggests a strong correlation between past practices and the current distribution of metals.

One off-site sample, SO-2, contained the maximum concentration for three different metals. Although the sample was obtained off-site, it occurs within the boundary of the former landfill burn area. Metal exceedances were also found throughout the remainder of the site; although, their distribution does not correlate strongly with locations where wastes were managed or disposed and suggests that the exceedances for some metals are a reflection of elevated background levels. The source of elevated metal concentrations at background locations is not known. It is possible that the locations are not actually representative of background, as they may have been impacted by site activities. Considering that the entire peninsula is built from dredge spoils, it is possible that the underlying fill is the source of the elevated metals concentrations.

2.1.2.2 Sediments

Thirty-four sediment samples, including duplicates, were obtained from on-site and off-site areas. Eight background samples were collected from areas around Sabine Lake. Eleven samples, including two duplicates (SE-10 and SE-33), were obtained for source characterization proximal to the site. Eight of the 11 samples were analyzed for the complete list of organic and inorganic compounds discussed earlier. Samples SE-13/SE-33 and SE-26 were not analyzed for organic compounds. CH2MHill in their 1999 Technical Memorandum limited the discussions below to only those samples collected near the site.

The results of sampling identified several organic and inorganic compounds in each area.

Organics

VOCs were detected infrequently and at relatively low levels in several samples. None of the VOCs detected exceeded the PRGs. Two of the detected VOCs, acetone and methylene chloride, are potential laboratory contaminants and may not be site related. SVOCs consisting of PAHs were encountered in five of seven samples analyzed for SVOCs. Each of these five samples was collected adjacent to areas where petroleum products were managed or disposed. All five samples, including one duplicate (SE-10), contained PAHs at concentrations that exceeded the PRGs. Up to 13 different PAHs were detected above the PRGs including benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, and benzo(k)fluoranthene. These compounds were detected in all of the waste areas. Additional exceedances are possible because the laboratory quantitation limit for most SVOCs was greater than the respective PRG.

Aroclor-1242, a PCB, and lindane, a pesticide, were each detected in one sample at concentrations below the PRGs. Gamma-BHC (lindane), another pesticide, was detected in sample SE-8 above the PRG.

Metals

Metals were identified in all the samples collected. All the sediment samples contained at least one metal occurring at concentrations above the PRGs. Metals exceeding PRGs included arsenic, copper, iron, lead, manganese, mercury, nickel, and zinc. The PRG developed for mercury is below the laboratory quantitation limit for most of the samples, and therefore, it is uncertain whether mercury is present above the PRG.

Distribution of Contamination

Excerpt 2 (Figure 3-2 CH2Mhill, 1999) illustrates the distribution of organic compounds that exceeded the PRGs in sediment. PAH exceedances are found in the five sediment samples closest to the dock barges, SE-8, SE-9, SE-11, SE-14, and SE-15. All the sediment samples contained an exceedance for arsenic. This was the only exceedance in SE-26, located farthest

from the shoreline. Sample SE-7, located upstream of the site, contained only two exceedances (arsenic and manganese). The highest levels of metals contamination generally occurs between and/or adjacent to the two dock barges (see Excerpt 2).

2.1.2.3 Surface Water

Nine surface water samples were obtained by the TNRCC in 1996. Three of the nine samples, (SW-1 and SW-3) including one duplicate (SW-2), were obtained adjacent to the site, and their locations are shown in Excerpt 1. The remainder of samples were collected around Sabine Lake and in the Neches River; however, their specific locations are unknown.

Organics

There were no VOCs or pesticides and PCBs detected in any of the surface water samples. Two SVOCs were detected below PRGs. Benzo(g,h,i,)perylene was encountered at 0.0005 milligrams per liter (mg/L) in sample SW-1, which was obtained adjacent to the dock barge. Bis(2-Ethylhexyl)phthalate was detected in seven of the nine samples at concentrations ranging from 0.002 to 0.017 mg/L.

Metals

Metals were detected in all the samples and several metals in each sample were detected above the PRGs. Four of the exceedances are for metals whose laboratory quantitation limits are higher than the respective PRG. These metals included antimony, arsenic, selenium, and thallium. The remaining exceedances included aluminum, barium, cobalt, copper, lead, and vanadium. The highest reported concentration for each of these metals occurred at either SW-1 or SW-3.

Distribution of Contamination

Of the nine samples collected, the highest concentrations of metals occurred in the three samples obtained adjacent to the site, suggesting some impact to surface water from current or past site

activities. Given the uncertainty associated with water currents and dilution, it is not possible to delineate the extent of contamination in surface water.

2.1.3 Data Usability

Data to be used in the risk assessment will come from the 1996 TNRCC ESI, the 2000 WESTON ESI, and the planned WESTON RI/FS field work. Guidelines that will be followed when combining the data sets will be consistent with EPA and WESTON data management requirements as summarized below.

The data from both sampling events will first be sorted by medium. Data collected from the different sampling events will be evaluated to determine if concentrations are similar or if changes have occurred between sampling periods. If the methods used to analyze samples from different time periods have similar analyses conducted and QA/QC, and if the concentrations between sampling periods are similar, then the data will be combined for the purposes of quantitative risk assessment. If it is found that the concentrations of compounds have changed significantly between sampling periods, then only the most recent data will be used in the quantitative risk assessment. Justification for the elimination of any data will be separately described under the guidelines for data reduction for each of the risk assessments.

3. HUMAN HEALTH RISK ASSESSMENT

The objective of this section is to provide an overview of the methods to be used in conducting the baseline human health risk assessment (BHHRA) for the State Marine Superfund Site (SMS Site). The basic steps of the BHHRA are listed below and illustrated in Figure 2-1.

- Data Evaluation
- Exposure Assessment
- Toxicity Assessment
- Risk Characterization
- Uncertainty Analysis
- Preliminary Remediation Goals (PRGs)

Each of these steps is discussed in more detail in the following subsections.

The principal guidance documents and data bases that will be used in conducting the BHHRA include but are not limited to the following:

- *Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual (Part A)* (EPA, 1989a).
- *Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual (Part B), Development of Risk-Based Preliminary Remediation Goals* (EPA, 1991a).
- *Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual. Supplemental Guidance: "Standard Default Exposure Factors"* (EPA, 1991b).
- *Dermal Exposure Assessment: Principles and Applications* (EPA, 1992a).
- *Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, Supplemental Guidance, Dermal Risk Assessment* (EPA, 1998b).
- *Supplemental Guidance to RAGS: Calculating the Concentration Term* (EPA, 1992b).
- *Exposure Factors Handbook* (EPA, 1997a).
- *Guidance for Data Usability in Risk Assessment (Part A)* (EPA, 1992c).
- *Supplemental EPA Region 6 Risk Assessment Guidance* (EPA, 1995).

- Texas Risk Reduction Standards (30 TAC 335 Subchapter S) and the TNRCC 23 July 1998 Consistency Document (TNRCC, 1998b).
- Integrated Risk Information System (IRIS) (IRIS, 2000).
- Health Effects Assessment Summary Tables (EPA, 1997b).

3.1.1 Guidelines for Data Reduction

The following guidelines for data reduction will be used to produce the data summaries for each medium of concern for the human health baseline risk assessment (HHBRA). These approaches are consistent with *Risk Assessment Guidance for Superfund (RAGS), Volume 1, Human Health Evaluation Manual (Part A)* (EPA, 1989a), EPA Region 6 Risk Assessment Guidance (EPA, 1995), and the TNRCC Consistency Memorandum (TNRCC, 1998b).

- If a compound is not positively identified in any sample from a given medium, because it is reported as a nondetect and/or because of blank contamination (as explained below), it will not be addressed for that medium.
- If a compound is reported in a field sample and a method or field blank, it will be considered as a positive identification if the compound is present in the field sample at a concentration greater than 10 times (for common laboratory contaminants), or 5 times (for all other substances) the maximum concentration reported in any blank. Common laboratory contaminants include acetone, methylene chloride, methyl ethyl ketone (2-butanone), phthalate esters, and toluene.
- “J” values are estimated concentrations reported below the minimum confident quantitation limit. All data with “J” qualifiers will be assumed to be positive identifications for that medium, and the corresponding reported concentrations would be used.
- If a compound is reported as a non-detect in a sample set containing at least one detection, it will be assumed to be present at one-half of the sample quantitation limit for that sample in the calculation of the mean concentration and the 95% upper confidence limit concentration (UCL) of the arithmetic mean.
- Duplicate samples from the same sampling location will be considered as one data point in summarizing the frequency of detection. However, the analytical results of all duplicate samples will be used in summarizing the data and generating statistics.

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- For all sample locations where soils were sampled at multiple depths for a single location, the results from the various depths will be treated as individual data points in summarizing the data.
- Groundwater samples from the same well locations will be treated as individual data points in summarizing the data and generating statistics. Generally for risk assessment purposes, groundwater samples should be collected using the following guidelines (TNRCC, 1998b):
 - Sampling methodologies do not artificially increase or decrease naturally suspended particle concentrations.
 - Groundwater samples should be collected using a low flow rate (e.g., 0.1 liter/minute).
 - Groundwater samples should generally not be filtered.

In addition to the above, it is generally recommended that groundwater data used in a risk assessment should reflect potential shifts in concentrations due to seasonal influences. Available groundwater data will be reviewed for the quality requirements mentioned above.

- The determination of the 95% UCL in soil and/or sediment will be based on all data points.
- Total chromium results will be proportioned into 14% hexavalent chromium and 86% trivalent chromium based on information presented in IRIS (IRIS, 2000). This proportion was assumed by EPA when deriving the inhalation unit risk factor for hexavalent chromium (IRIS, 2000).

For the BHHRA, data will be summarized separately by medium. The data that will be summarized in the BHHRA include those for surface soil (0 to 6 inches bgs), surface/subsurface soil (0 to 4 or 5 feet deep [to be determined based on future sampling]), sediment and surface water from Sabine Lake, and on-site groundwater.

3.1.2 Guidelines for Selection of COPCs

The objective of this step is to screen the available analytical data for the media of concern to identify the COPCs associated with the SMS Site. The screening criteria that will be used to select or eliminate compounds as COPCs are based on EPA guidance (EPA, 1989a) as modified by EPA Region 6 (EPA, 1995). The following guidelines will be used in the BHHRA:

- A compound will generally be excluded as a COPC for a medium if it was not detected in any samples from that medium. However, a compound will be retained for the risk assessment if additional information suggests that the compound may be present at the site.
- A compound will be excluded as a COPC if it was detected in less than 5% of the samples and was not reported at concentrations exceeding EPA Region 6 PRGs and/or TNRCC Tier 1 protective concentration limits (PCLs) developed for residential soil. Note, at least 20 samples of a particular medium are needed before the frequency of detection rule can be applied.
- Arithmetic means will be calculated for the site-related and background data based on detected concentrations at each sampling location. Although site-related data for inorganics will be compared with background data, COPCs will not be screened out based on a background comparison. Rather, the BHHRA will evaluate risk based on all COPCs. In addition, the relative contribution of the inorganics, that are not above background, to the total risk will be considered separately and discussed further in the uncertainty analysis.
- Inorganic compounds that are (1) essential human nutrients, (2) present at low concentrations (i.e., only slightly elevated above naturally occurring levels), and (3) toxic only at very high doses (e.g., calcium, iron, potassium, magnesium, and sodium) will not be evaluated as COPCs.
- Selection of surface water COPCs will be conservatively based on on-site groundwater data. Groundwater data will be diluted by a factor of 10 and then compared to applicable PRGs for residential tap water.

3.2 EXPOSURE ASSESSMENT

The objectives of the exposure assessment are to characterize potentially exposed human populations in relation to on-site and off-site areas at the SMS Site, to identify actual or potential exposure pathways, and to determine the potential extent of exposure. The exposure assessment involves several elements including the following:

- Definition of local land and water uses.
- Identification of the potential receptors/exposure scenarios (Site Conceptual Model).
- Identification of exposure routes (Site Conceptual Model).
- Estimation of exposure point concentrations.

- Identification of the exposure models and assumptions used to calculate daily intakes or doses.
- Estimation of doses.

The following subsections discuss each of these key technical elements in relation to the on-site and off-site areas associated with the SMS Site.

3.2.1 Land and Water Uses

3.2.1.1 Land Uses

The SMS Site is located in an industrial area within the city limits of Port Arthur in central eastern Jefferson County, Texas. The Sabine-Neches Canal forms the eastern border of the site. The site is bordered to the north by Palmer Barge Lines, to the west by Old Yacht Club Road, and to the south by undeveloped land. The land use surrounding the site is mostly industrial and recreational.

SMS Site operations began about 1973 under the names of State Welding and Marine Works and the Golden Triangle Shipyard. The specific operations at the site at that time are unknown but are likely to have included marine salvage and repairs. In 1974, the Texas Department of Water Resources (TDWR) issued a water quality discharge permit to State Marine that authorized disposal of treated wastewater into the Sabine-Neches Canal, suggesting that barge cleaning operations were either conducted or planned at the time.

In 1995, an Agreed Final Judgment Order was signed with the property owner specifying that no activities could be conducted at the site without permission of the state (CH2MHill, 1999). Currently, activities at the site are limited to salvage operations and environmental investigations.

3.2.1.2 Water Uses

Information pertaining to surface water and groundwater use at the site is provided below.

Surface Water Use

The SMS Site is located directly along the shores of Sabine Lake, within the 100-year flood plain, approximately ½ mile southwest of the point where the Neches River enters the Sabine-Neches Canal. Sabine Lake is defined as a bay or estuary (TNRCC, 1998a). Sabine Lake not only receives water from Jefferson County and the basin of the Neches River, but also from Sabine River. This water passes into the Gulf of Mexico through Sabine Pass, a body of salt water lying between Jefferson County and Cameron Parish, Louisiana (USDA SCS, 1965).

On a more local scale, surface water at the site drains in an easterly direction across the site and discharges directly in to Sabine Lake at the bulkhead or dock.

Most of the water supply for Jefferson County comes from the Neches River. Small towns and communities in the county obtain their water from wells, but the larger cities obtain their water from the Neches River by way of open canals and treatment plants (TNRCC, 1998a).

Based on information provided in the TNRCC SSI, Sabine Lake is considered a fishery. Designated water uses for the in-water segment are contact recreation, exceptional quality aquatic habitat, and shellfish waters (TNRCC, 1998a). Redfish, drum, speckled trout, and croaker are abundant in Sabine Lake. Crabbing is excellent year-round. An abundance of wetland areas and a National Wildlife Refuge lie along the banks of the lake and downstream waterways.

Groundwater Use

The principle source of fresh to saline groundwater in the study area is the Gulf Coast Aquifer, which consists of alternating beds of clay, silt, sand, and gravel which are hydrologically connected and form a large, leaky artesian aquifer system. The Gulf Coast Aquifer ranges in age from Miocene to Holocene and is composed of sediments of the Catahoula, Oakville, Fleming, Goliad, Willis, Bentley, Montgomery, and Beaumont Formations as well as the Quaternary Alluvium. The Gulf Coast Aquifer has been subdivided into the Chicot Aquifer composed of the Willis, Bentley, Montgomery, and Beaumont Formations and the Evangeline Aquifer that includes the Goliad Formation. Depth to groundwater ranges from 2 to 60 feet based on private wells drilled within a 4-mile radius of the site (TNRCC, 1998a).

The quality of groundwater produced from the Gulf Coast Aquifer is good, containing less than 1,000 mg/L of total dissolved solids. However, areas of more highly mineralized water exist south of Beaumont to the coast in Jefferson County (TNRCC, 1998a).

Locally, groundwater is not known to be used for drinking purposes. Because of the underlying former City of Port Arthur Landfill, which precludes use of shallow groundwater, and the site's proximity to brackish surface water, groundwater is believed to be non-potable (CH2MHill, 1999). Information regarding total dissolved solids (TDS) and potential yield in gallons per minute is needed to evaluate if groundwater in the shallow aquifer could potentially be used as a potable drinking water source.

Based on a water well survey conducted by TNRCC, one domestic well is located approximately one mile away in a hydraulically upgradient direction (TNRCC, 1998a). In addition, 33 public, industrial, unknown use, test, and domestic water wells have been identified within a 4-mile radius of the site using State of Texas water well logs and TNRCC Public Water Supply inspection reports (TNRCC, 1998a). However, the site is slightly elevated along the western property boundary and gradually slopes toward Sabine Lake. Thus, all groundwater wells identified appear to be located upgradient or cross-gradient of the SMS Site.

3.2.2 Site Conceptual Model

A site conceptual model describes the potential chemical sources, affected media, routes of migration, and known or potential human receptors and exposure routes. The purpose of the site conceptual model is to provide a framework for problem definition, to aid in the identification of data gaps, and to assist in the identification of appropriate remedial technologies, if needed.

The site conceptual model for the SMS Site is shown in Figure 2-2. Based on the potential contaminant migration routes at the SMS Site, along with current and predicted future land and water uses, receptors were chosen for evaluation in the BHHRA. The site conceptual model also shows pathways associated with ecological receptors. Ecological receptors are discussed in detail in Section 3 of this work plan. These receptors along with potential exposure routes by which these receptors may be exposed to site-related compounds are indicated in the conceptual model and discussed further in the following subsections.

3.2.3 Identification of Potential Receptors/Exposure Scenarios

The BHHRA will focus on those receptors that are likely to be maximally exposed to each of the contaminated media currently and in the future. This approach ensures that the maximum potential risk will be characterized and that all potential receptors will be adequately protected. Each receptor that is included in the BHHRA will be evaluated using both central tendency exposure (CT) and reasonable maximum exposure (RME) assumptions. The RME case is designed to be a measure of high-end exposure and ultimately leads to an estimate of upperbound risk. The CT case is intended to provide average exposure estimates which may be more representative of the typically exposed individual.

The site conceptual model (Figure 2-2) identifies four types of human health receptors that will be evaluated: a current on-site trespasser, a current on-site worker, a future on-site worker, and a current recreational user. The following subsections describe the scenarios that will be evaluated, including the potential exposure routes. The exposure durations, exposure times, and exposure frequencies that will be assumed for each scenario also are discussed.

3.2.3.1 EPS-1 (Current Use) - Trespassers Potentially Exposed to Surface Soil, Sediment, and Surface Water

The SMS Site is not totally fenced, and the entrance to the site is not controlled. Based on this, the possibility of trespassers gaining access to the site cannot be ruled out. Therefore, the trespasser scenario (EPS-1) was chosen to evaluate risks from exposure to on-site surface soil and sediment/surface water associated with Sabine Lake. Exposure to surface water/sediment was assumed to occur during contact activities such as wading in the near shore area of Sabine Lake. Swimming will not be evaluated for the trespasser scenario because it was assumed to be a more likely occurrence under the recreational scenario.

For the RME and CT scenarios, the trespasser was assumed to be a youth, 7 to 18 years old. For the trespasser, an exposure duration of 10 years (both RME [EPA, 1995] and CT scenarios) and an exposure frequency of 60 days per year for the RME scenario (EPA, 1995) and 30 days per year for the CT scenario (represents 50% of the RME) were used. For the RME and CT scenarios, the trespasser was assumed to be on the site for approximately 2.6 hours (EPA, 1995) and 1.3 hours (estimated) per exposure event, respectively. The exposure time for the CT scenario was assumed to be one-half that of the RME scenario. Note, exposure time is a parameter used in the surface water intake equation.

3.2.3.2 EPS-2 (Current Use) – On-Site Workers Potentially Exposed to Surface Soil, Sediment, and Surface Water

The evaluated receptor for EPS-2 is the current industrial worker potentially exposed to on-site surface soil and sediment/surface water associated with Sabine Lake. Selection of this receptor was based on the current land use at the site and the most likely future land use (i.e., commercial/industrial).

Current industrial workers were assumed to be exposed to soil and sediment/surface water during work activities. It was assumed that exposure to Sabine Lake surface water and sediment would be limited to wading activities. Further assumptions regarding exposure to soil and sediment/surface water are discussed below.

Soil Exposure

For current industrial workers, exposure durations of 25 and 9 years were used for the RME and CT scenarios, respectively (EPA, 1995). The exposure frequency for exposure to soil was assumed to be 250 days per year for both the RME and CT scenarios (EPA, 1995).

Sediment/Surface Water Exposure

For current industrial workers, exposure durations of 25 and 9 years were used for the RME and CT scenarios, respectively (EPA, 1995). The exposure frequency for exposure to surface water and sediment was estimated to be 100 days/year for both RME and CT scenarios. For the RME and CT scenarios, the current/future industrial worker was estimated to be on the site for approximately 1 and ½ hours per exposure event, respectively. The exposure time for the CT scenario was assumed to be one-half that of the RME scenario.

3.2.3.3 EPS-3 (Future Use) – On-Site Workers Potentially Exposed to Surface/Subsurface Soil, Sediment, Surface Water, and Groundwater

The evaluated receptor for EPS-3 is the future industrial worker potentially exposed to on-site surface/subsurface soil, sediment/surface water associated with Sabine Lake, and on-site groundwater. It was assumed that on-site soil would become mixed during future re-development activities. Selection of this receptor was based on the current land use at the site and the most likely future land use (i.e., commercial/industrial).

Current industrial workers were assumed to be exposed to soil, sediment/surface water, and groundwater during work activities. It was assumed that exposure to Sabine Lake surface water and sediment would be limited to wading activities. Also, for exposure to groundwater, it was assumed that workers would be exposed through ingestion and showering.

The exposure assumptions (i.e., exposure frequency, exposure duration, and exposure time) for the future on-site industrial worker based on exposure to soil, sediment, and surface water are the same as those described for the current on-site industrial worker. Exposure assumptions for groundwater are summarized below.

For current industrial workers, an exposure duration of 25 and 9 years were used for the RME and CT scenarios, respectively (EPA, 1995). The exposure frequency for exposure to groundwater was assumed to be 250 days per year for both the RME and CT scenarios (EPA, 1995). Exposure times for showering were assumed to be 0.2 hours per day (EPA, 1995) and 0.12 hours per day (EPA, 1989a) for the RME and CT scenarios, respectively.

Groundwater beneath the site will be evaluated for its potable qualities prior to calculating risks based on industrial tap water ingestion and non-ingestion scenarios. TNRCC guidance on groundwater potability as presented in the Texas Risk Reduction Program (TRRP) will be used to evaluate the potability of State Marine groundwater (TAC §350.52. Groundwater Resource Classification). According to the TRRP, an aquifer may not be considered to be potable if it meets the conditions of “Class 3 Groundwater”. According to TRRP, *Class 3 groundwater resources include any groundwater-bearing unit which produces water with a naturally occurring TDS content of greater than 10,000 mg/l or at a sustainable rate less than 150 gallons per day to a well with a four inch diameter casing or an equivalent sustainable rate in gallons per day to a well with a smaller or larger diameter casing.*

TDS, salinity, and yield (in gallons per minute) will be measured from each of 4 on-site groundwater monitoring wells. If it is determined that on-site groundwater meets the TRRP definition of “Class 3”, then exposure to future industrial workers from ingestion and non-ingestion use of groundwater will not be quantitatively evaluated in the BHHRA. Rather, detected concentrations in on-site groundwater will be qualitatively evaluated as described below.

- Detected concentrations in on-site groundwater will be compared to TNRCC Tier 1 PCLs developed for Class 3 groundwater (^{GW}GW_{Class 3}) (TAC §350; Subchapter D; Table 3).
- Detected concentrations in on-site groundwater will be compared to 10 times federal AWQC human health values for consumption of water and organisms (EPA, 1998a).

3.2.3.4 EPS-4 (Current Use) – Recreational Users Potentially Exposed to Sediment and Surface Water in Sabine Lake

Sabine Lake is considered a fishery and used for contact and recreational uses. As such, the evaluated receptor for EPS-4 is a current recreational user potentially exposed to sediment and surface water associated with Sabine Lake during recreational activities such as swimming and fishing.

The recreational user is considered to be a 7 to 18 year old youth. Exposure to surface water was assumed to occur during recreational contact activities such as swimming. For the recreational user, an exposure duration of 10 years was used (EPA, 1995) with an exposure frequency of 12 days per year (1 event/month) (EPA, 1997a). The recreational user was assumed to be swimming for approximately 1 hour/event (EPA, 1997a).

Note, indirect exposure through the ingestion of fish will not be quantitatively evaluated in this BHHRA. Rather, the use of fish tissue data from the nearby Calcasieu Estuary will be used to qualitatively assess potential impacts to humans from potential ingestion of fish in Sabine Lake that may have been impacted by the SMS Site. A qualitative assessment will be made by comparing Calcasieu Estuary sediment and surface water concentrations to concentrations detected in the Lake Sabine off-site investigation area.

3.2.3.5 Summary of Scenarios

The scenarios that will be evaluated in the BHHRA are summarized in Table 2-1. The table presents the receptors and the exposure routes that will be evaluated quantitatively.

3.2.4 Exposure Point Concentrations

The approaches that will be used to calculate exposure concentrations will be medium-specific. These approaches are discussed in the following subsections.

3.2.4.1 Soil

Exposure point concentrations for soil will be developed taking into account potential “hot spots” of contamination. The term “hot spot” is used to describe a localized area where one or more compounds occur in concentrations substantially greater than those found elsewhere in the remainder of a facility zone. The distribution of compounds on the site will be reviewed to determine if hot spots exist. If a hot spot is identified, the hot spot data will be evaluated independently of the data representing the remainder of the zone (i.e., separate exposure concentrations will be calculated for the hot spot and the rest of the zone). This approach should facilitate prioritization of remedial actions in specific portions of a facility zone and help define the extent of any necessary remediation.

For the current trespasser and industrial worker scenario, the exposure concentrations for soil will be based on surface soil. A depth of 0 to 6 inches bgs is recommended for estimating exposure based on contact with surface soil (EPA, 1995). For the future industrial worker scenario, the exposure concentrations will be based on surface and subsurface soil combined (i.e., 0 to 4 or 5 feet deep [dependent on future sampling depth]). In the future scenario, it is assumed that some excavation of the soil will occur and that surface and subsurface soil become mixed and available for contact.

Consistent with EPA and EPA Region 6 guidance (EPA, 1992b; EPA, 1995), exposure point concentrations for both the CT and RME cases will be calculated for each data set based on the 95% UCL concentrations of the arithmetic means of the log transformed data, using an equation recommended by EPA (EPA, 1992b). If the 95% UCL concentration exceeds the maximum detected concentration for a compound, the maximum detected concentration will be used as the exposure point concentration.

3.2.4.2 Groundwater

Groundwater data is not available for the SMS Site. However, groundwater samples are planned for the SMS RI/FS. Generally for risk assessment purposes, groundwater samples should be collected using the following guidelines (TNRCC, 1998b):

- Sampling methodologies do not artificially increase or decrease naturally suspended particle concentrations.
- Groundwater samples should be collected using a low flow rate (e.g., 0.1 liter/minute).
- Groundwater samples should generally not be filtered.

In addition to the above, it is generally recommended that groundwater data used in a risk assessment should reflect potential shifts in concentrations due to seasonal influences.

Groundwater data collected from the site during future investigations (i.e., RI/FS) will be reviewed for quality based on the above criteria and the procedure presented below will be used in calculating the exposure point concentration.

According to EPA Region 6, the estimated exposure point concentration for groundwater should be represented by the mean chemical concentration in those wells that represent the center of the plume. Potential risks for on-site groundwater will be based on the mean concentration of COPCs present in those on-site wells that have been maximally impacted.

3.2.4.3 Surface Water and Sediment

The exposure concentrations for sediment in Sabine Lake will be based on the 95% UCL of the mean concentration as described for soil.

Shallow groundwater data collected from future on-site wells along the near shore area (intertidal groundwater) will be used to conservatively represent surface water concentrations in Sabine Lake. This data will be used to evaluate surface water exposure to all receptors. This is a worst case scenario designed to protect surface water from current groundwater discharges into Sabine Lake. Surface water samples collected from Sabine Lake would be diluted and not representative of worst case conditions.

3.2.4.4 Recreationally Caught Fish and Shellfish

Site-specific exposure point concentrations will not be calculated for fish as part of this BHHRA. Instead, the use of fish data from the nearby Calcasieu Estuary will be used to qualitatively assess

potential indirect impacts to humans from the ingestion of fish that may have been exposed site-related contaminants in Sabine Lake.

3.2.4.5 Air

Exposure through the air pathway will be evaluated for three exposure routes: the inhalation of particulate generated from soil, the inhalation of volatile emissions from soil, and the inhalation of VOCs through non-ingestion water use (e.g., showering). In the absence of air monitoring data, exposure concentrations for the air pathway will be modeled based on the concentrations of compounds in soil and groundwater. The exposure concentrations for air will not be presented separately, but will be incorporated into the equations that will be used to calculate contaminant intakes through the air pathway. The models that will be used for the air pathway are those recommended by EPA in the *Soil Screening Guidance: Technical Background Document* (EPA, 1996a).

The exposure concentrations for the inhalation of particulates generated from soil exposure route will be estimated based on the corresponding exposure concentrations for soil (i.e., based on surface soil for the current trespasser and industrial worker scenarios; 0 to 4 to 5 feet bgs [depending on available data] for the future industrial worker scenario). For all receptors exposed to on-site soil, exposure concentrations for the inhalation of volatile emissions from soil exposure routes will be estimated based on the 95% UCL of the mean chemical concentration of the available soil data up to a depth reaching groundwater level or a near impermeable layer (EPA, 1991a). The air exposure concentrations for the noningestion water use exposure route will be calculated from the corresponding exposure concentrations for groundwater.

3.2.5 Identification of Exposure Models and Assumptions

3.2.5.1 Approach

This section describes the mathematical models that will be used to calculate the intakes (i.e., the doses) of the COPCs for each receptor through the applicable exposure routes. The mathematical models used to calculate intakes are presented in Tables 2-2 through 2-13. Each table defines the

variables used in estimating doses and includes the assumptions (i.e., exposure parameters) used in the model. Most of the exposure parameters that were used are standard values recommended by EPA and EPA Region 6 guidances. When agency-recommended values were not available, professional judgment was used. The basis for the exposure time, exposure frequency, and exposure duration assumptions were presented in Subsection 2.2.3. Additional information and discussion of the rationale behind the assumptions for each exposure route are presented in the following subsections.

The exposure assumptions for each medium, with the exception of groundwater, were based on the assumption that no hot spots are detected. If a hot spot is identified, some exposure assumptions may need to be modified to account for the areal extent of the hot spot relative to the medium being evaluated.

Two sets of doses will be calculated using the mathematical models discussed in the following subsections. One set, in which the doses are averaged over the exposure duration, will include all of the COPCs and will be used to evaluate the potential for noncarcinogenic health effects. The other set, in which the doses are averaged over a 70-year lifetime, will include only carcinogens and will be used to evaluate potential carcinogenic risk. The exposure doses will be expressed as intakes or absorbed doses, in milligrams contaminant per kilogram body weight per day (mg/kg-day).

3.2.5.2 *Incidental Soil Ingestion*

Incidental soil ingestion could result from placing dirt-contaminated hands or objects in the mouth (e.g., cigarettes). This exposure route will be evaluated for the on-site scenarios (i.e., current trespasser and industrial worker, and future industrial worker). The equation and assumptions that will be used to calculate intakes through the incidental ingestion of soil are presented in Table 2-2.

A soil ingestion rate of 100 mg/day will be used for the CT and RME trespasser scenarios. This value is recommended by EPA Region 6 for a trespasser (EPA, 1995). It is conservatively assumed that 100% of the ingested soil is from a contaminated source.

For the current and future industrial worker scenarios, an assumption of 50 mg/day will be used as the soil ingestion rate for the CT and RME cases. All of the soil ingested in both the CT and RME cases will be assumed to be from a contaminated source.

3.2.5.3 Dermal Contact with Soil

Dermal contact with soil could result in the absorption of compounds through the skin. This exposure route will be evaluated for the on-site scenarios (i.e., current trespasser and industrial worker, and future industrial worker). The equation and assumptions that will be used to calculate absorbed dermal doses through skin contact with soil are presented in Table 2-3.

Based on information presented in Table 6-6 of the 1997 Exposure Factors Handbook (EPA, 1997a), exposed skin surface areas of 3,800 squared centimeters (cm^2) and 4,600 cm^2 will be used for the CT and RME trespasser scenario, respectively. Fiftieth and 95th percentile total body surface areas for male children, beginning with the 7 < 8 year age category and ending with the 17 < 18 year age category, were used to derive an average total body surface area for the CT and RME trespasser scenarios, respectively. Based on the assumption that up to 25% of the skin area may be exposed to soil (EPA, 1997a), the aforementioned average total body surface areas were multiplied by 25% to derive representative skin surface areas for the CT and RME scenarios.

For the current and future industrial worker scenarios, a skin surface area of 5,000 cm^2 /day was used (EPA, 1992a) for both the RME and CT scenarios. This surface area represents 25% of the mean total body surface area for an adult.

Soil-to-skin adherence factors of 0.2 mg/cm^2 and 1.0 mg/cm^2 will be assumed for the CT and RME cases, respectively, for both the trespasser and industrial worker scenarios. These factors represent central and upper-end values recommended by EPA (EPA, 1992a).

Compound-specific dermal absorption factors recommended by EPA, EPA Region 6, or TNRCC (EPA, 1992a; EPA 1995; TNRCC, 1998b), will be used when available. Because very few compound-specific values have been developed by EPA or EPA Region 6, default dermal

absorption factors recommended by EPA Region 6 (i.e., 0.1 for organics and 0.01 for metals) will be used for most of the compounds of concern (EPA, 1995).

3.2.5.4 Inhalation of Particulates

The inhalation of airborne particulates that are generated from soil will be evaluated for the on-site scenarios (i.e., current trespasser and industrial worker, and future industrial worker). The intake equation and the assumptions that will be used to calculate doses from the inhalation of particulates are summarized in Table 2-4.

An inhalation rate of 10 cubic meters per day (m^3/day) will be assumed for the CT and RME trespasser scenarios. This value was estimated based on 4 hours of moderate activity for an adult (EPA, 1997a). An inhalation rate of 20 m^3/day , recommended by EPA for a worker (EPA, 1991b), will be used for both the CT and RME current and future industrial worker scenarios.

The equation for calculating intakes through the inhalation of particulates includes a particulate emission factor (PEF). The PEF translates the contaminant concentration in soil (by weight) to an estimated contaminant concentration in air (by volume). In the absence of site-specific data, EPA has recommended a default PEF of $1.32 \times 10^9 \text{ m}^3/\text{kg}$ (EPA, 1996b). The emissions used to derive the default value were based on the “limited reservoir” model developed to estimate particulate emissions due to wind and erosion. The equation used to calculate the default value assumes that 50% of the site is covered with vegetation. The default PEF value of $1.32 \times 10^9 \text{ m}^3/\text{kg}$ will be used to evaluate the CT and RME cases in all current and future on-site scenarios.

3.2.5.5 Inhalation of Volatile Emissions from Soil

The inhalation of volatile emissions from soil will be evaluated for the on-site scenarios (i.e., current trespasser and industrial worker, and future industrial worker). The intake equation and the assumptions that will be used to calculate doses are summarized in Table 2-5.

The inhalation rates will be the same as those assumed for the inhalation of particulates exposure route. The compound-specific volatilization factors will be calculated according to the methodology recommended in the Soil Screening Guidance (EPA, 1996).

3.2.5.6 Drinking Water Ingestion

Drinking water ingestion will be considered a potential route of exposure for the future on-site industrial worker. The intake equation and assumptions that will be used to calculate doses from drinking water ingestion are presented in Table 2-6.

Drinking water ingestion rates recommended by EPA (EPA, 1991b) and/or EPA Region 6 (EPA, 1995) will be used for all scenarios. Ingestion rates of 0.7 L/day and 1 L/day will be used, respectively, for the CT and RME cases for the future industrial worker.

If WESTON determines that on-site groundwater meets the TRRP definition of “Class 3”, then exposure to future industrial workers from ingestion of groundwater will not be quantitatively evaluated in the BHHRA. Instead, detected concentrations in on-site groundwater will be qualitatively evaluated as discussed in Section 3.2.3.3.

3.2.5.7 Noningestion Water Use (Showering)

Noningestion water use (i.e., showering) can result in exposure to compounds as a result of the inhalation of volatilized compounds or dermal absorption. Exposure to compounds through both inhalation and dermal absorption resulting from showering will be evaluated for the future on-site industrial worker.

Inhalation of Volatilized Compounds

The equation and assumptions that were used to calculate intakes through the inhalation of volatile organics are presented in Table 2-7. In accordance with EPA Region 6 guidance (EPA, 1995), a model presented in the *Human Health Evaluation Manual, Part B: Development of Risk-Based Preliminary Remediation Goals* (EPA, 1991a) will be used to calculate inhalation intakes through

noningestion water use. It should be noted that the model is meant to be applied to household noningestion use in general and not specifically to showering.

An inhalation rate of 0.6 m³/hour, which is based on light activity (EPA, 1989a), will be used for the future industrial worker for both the RME and CT scenarios. The indoor inhalation of volatiles will be evaluated only for those compounds with a Henry's Law Constant of 1E-05 atm-m³/mole or greater and a molecular weight of less than 200 g/mole (EPA, 1991a).

Dermal Absorption

In accordance with EPA Region 6 guidance, dermal absorption through showering will be evaluated only for these COPCs with a permeability coefficient of greater than 0.01 cm/hr (EPA, 1995). The equation and assumptions that will be used to evaluate this exposure route are presented in Table 2-8.

For the industrial worker, a surface area of 20,000 cm² will be used for the CT and RME scenarios (EPA, 1995). The dermal permeability coefficients will be obtained, where available, from EPA (EPA, 1992a). Measured values will be used in preference to values estimated by EPA, unless the measured value has a low level of confidence (i.e., weight of evidence of 55 or less out of 100), in which case the estimated value will be used. If EPA provides neither an estimated nor a measured permeability coefficient, a value will be calculated using the equation recommended by EPA (EPA, 1992a).

If WESTON determines that on-site groundwater meets the TRRP definition of "Class 3", then exposure to future industrial workers from ingestion of groundwater will not be quantitatively evaluated in the BHHRA. Instead, detected concentrations in on-site groundwater will be qualitatively evaluated as discussed in Section 3.2.3.3.

3.2.5.8 Incidental Ingestion of Surface Water

Doses from the ingestion of surface water will be calculated for the recreational user because surface water ingestion could result during recreational activities such as swimming. The equation

and assumptions that will be used for the RME and CT scenarios to calculate intakes through the incidental ingestion of surface water for the recreational user are presented in Table 2-9.

Based on a swimming scenario, an ingestion rate of 0.05 liters/hour will be used for both the RME and CT scenarios (EPA, 1989c).

3.2.5.9 Dermal Contact with Surface Water

Doses from dermal contact with surface water will be calculated for current trespassers, current and future industrial workers, and recreational users in Sabine Lake. The equation and the assumptions that will be used for the RME and CT scenarios to calculate absorbed doses resulting from dermal contact with surface water are summarized in Table 2-10.

Surface water contact for the trespasser and industrial worker will be assumed to be limited to wading activities in the near shore area of Sabine Lake. Based on information presented in Table 6-6 of the 1997 Exposure Factors Handbook (EPA, 1997a), exposed skin surface areas of 3,800 cm² and 4,600 cm² will be used for the CT and RME trespasser scenario, respectively. Fiftieth and 95th percentile total body surface areas for male children, beginning with the 7<8 year age category and ending with the 17 < 18 year age category, were used to derive an average total body surface area for the CT and RME trespasser scenarios, respectively. For the industrial worker, an exposed skin surface area of 5,000 cm² (EPA, 1995) will be used for the RME and CT scenarios. This value represents 25% of the mean total body surface area of an adult (EPA, 1992a). Contact for the current recreational user was assumed to include swimming in Sabine Lake. Skin surface areas of 15,000 cm² and 18,500 cm² will be used for the recreational user for CT and RME scenarios, respectively. Fiftieth and 95th percentile total body surface areas for male children, beginning with the 7 < 8 year age category and ending with the 17 < 18 year age category, were used for the CT and RME recreational scenarios, respectively.

Compound-specific dermal permeability coefficients will be obtained, if available, from the *Dermal Exposure Assessment: Principles and Applications, Interim Report* (EPA, 1992a). Otherwise, permeability coefficients will be calculated using an equation from the aforementioned reference. Permeability coefficients will be calculated using the following equation (EPA, 1992a):

$$\log k_p = -2.72 + (0.71 \times \log k_{ow}) - (0.0061 \times \text{molecular weight})$$

3.2.5.10 Incidental Sediment Ingestion

Similar to soil ingestion, incidental sediment ingestion could result from placing sediment-contaminated hands or objects in the mouth. Doses from incidental ingestion of sediment will be calculated for current trespassers, current and future industrial workers, and current recreational users in Sabine Lake. The equation and assumptions that will be used for the RME and CT scenarios to calculate intakes through the incidental ingestion of sediment for the aforementioned receptors are presented in Table 2-11.

For the current and future industrial workers, a sediment ingestion rate of 50 mg/day (EPA, 1995) will be used for both the RME and CT scenarios. A sediment ingestion rate of 100 mg/day will be used for the trespasser (EPA, 1995) and the recreational user (estimated) for both the RME and CT scenarios.

3.2.5.11 Dermal Contact with Sediment

Similar to dermal contact with soil, dermal contact with sediment could result in absorption of compounds through the skin. Doses from dermal contact with sediment will be calculated for current trespassers, current and future industrial workers, and current recreational users in Sabine Lake. The equation and assumptions that will be used for the RME and CT scenarios to calculate intakes through the dermal contact with sediment for the aforementioned receptors are presented in Table 2-12.

Based on information presented in Table 6-6 of the 1997 Exposure Factors Handbook (EPA, 1997a), exposed skin surface areas of 3,800 cm² and 4,600 cm² will be used for the CT and RME trespasser and recreational scenario, respectively. A skin surface area of 5,000 cm²/day (EPA, 1995) will be used for the industrial worker for both the RME and CT scenarios. This surface area represents 25% of the mean total body surface area for an adult (EPA, 1992a).

Soil-to-skin adherence factors of 0.2 mg/cm² and 1.0 mg/cm² will be assumed for the CT and RME cases, respectively, for the trespasser, the recreational user, and the industrial worker scenarios. These factors represent central and upper-end values recommended by EPA (EPA, 1992a).

Compound-specific dermal absorption factors recommended by EPA, EPA Region 6, or TNRCC (EPA, 1992a; EPA 1995; TNRCC, 1998b), will be used when available. Because very few compound-specific values have been developed by EPA or EPA Region 6, default dermal absorption factors recommended by EPA Region 6 (i.e., 0.1 for organics and 0.01 for metals) will be used for most of the chemicals of concern (EPA, 1995).

3.3 TOXICITY ASSESSMENT

The toxicity assessment will identify the toxicity values (i.e., reference doses and cancer slope factors) for the COPCs at the SMS Site. These toxicity values will be applied to the estimated doses to evaluate carcinogenic and noncarcinogenic risks. IRIS, an EPA-maintained computerized database, will be the preferred source of toxicity values (IRIS, 2000). If a toxicity value is not available through IRIS, EPA's Health Effects Assessment Summary Tables (HEAST) will be consulted (EPA, 1997b). A list of the toxicity values that are not available either on IRIS or in HEAST will be submitted to EPA Region 6 for further assistance (EPA, 1995). In cases where there are no values available from IRIS or HEAST, the National Center for Environmental Assessment (NCEA) toxicity values found in the most recent EPA Region 6 PRG Table will be used. If an EPA or EPA Region 6 approved toxicity value is not available for a compound, the compound will not be evaluated quantitatively, but will be carried through the risk assessment and discussed qualitatively in the uncertainty analysis.

Cancer slope factors (CSFs) will be identified for those COPCs classified by EPA as carcinogens, and reference doses (RfDs) will be identified for all COPCs. Chronic RfDs, which are intended to be used to evaluate exposures of greater than 7 years (EPA, 1989a), will be used to evaluate the CT and RME cases for all scenarios.

RfDs and CSFs will be expressed as a dose and an inverse of the dose, respectively, in units of mg/kg-day. Inhalation reference concentration (RfCs) and cancer unit risk factors will be converted to RfDs and CSFs, respectively, according to EPA guidance (EPA, 1997b).

Dermal toxicity values will be derived from the corresponding oral values according to EPA guidance (EPA, 1989a) using gastrointestinal (g.i.) absorption factors. When available, compound specific values will be used. Sources for compound specific values will include values listed in Attachment C of the TNRCC Consistency Memorandum (TNRCC, 1998b) and those available from ORNL. In the absence of compound specific values, default g.i. absorption factors of 1.0 and 0.3 will be used for organics and metals, respectively (EPA, 1995).

An adult lead model, which predicts fetal blood lead levels, will be used to evaluate soil lead exposure to current and future industrial workers. The methodology used to calculate fetal blood lead levels is in accordance with a draft guidance provided by EPA Region 6 for calculating lead cleanup levels for soil based on fetal exposure (i.e., “Adult Lead Cleanup Level” Model). The draft EPA Region 6 guidance is a modification of a model developed by Bowers et al (1994).

3.4 RISK CHARACTERIZATION

The objective of the risk characterization is to integrate the information developed in the exposure assessment and the toxicity assessment into an evaluation of the potential current and future health risks associated with the COPCs at the SMS Site. The potential for adverse noncancer health effects will be evaluated for all COPCs. The potential for cancer risk will be evaluated only for those compounds categorized by EPA as a Group A, B, or C carcinogen and for those compounds that are currently not categorized, but for which a cancer slope factor(s) is available. The total potential risks posed by all organic and inorganic COPCs (includes inorganics that are above and below background) will be distinguished from the total potential risks posed by all organic COPCs and only the inorganic COPCs that were detected above background.

3.4.1 Carcinogenic Risk

Potential cancer risk will be calculated by multiplying the estimated lifetime-averaged daily intake that is calculated for a compound through an exposure route by the exposure route-specific (oral, inhalation, or dermal) cancer slope factor (CSF), as follows:

$$\text{Risk} = \text{EDI} * \text{CSF}$$

Where:

EDI = Estimated daily intake (intake averaged over a 70-year lifetime) (mg/kg-day)

CSF = Compound- and route-specific cancer slope factor (mg/kg-day)⁻¹

For each scenario, the cancer risks will be added to calculate total risks for each compound, for each exposure route, and for all compounds and exposure routes.

3.4.2 Noncarcinogenic Risk

The potential for noncarcinogenic health effects will be evaluated by the calculation of hazard quotients (HQs) and hazard indices (HIs). An HQ is the ratio of the exposure duration-averaged estimated daily intake through a given exposure route to the compound and route-specific (oral, inhalation, or dermal) RfD. The HQ-RfD relationship is illustrated by the following equation:

$$\text{HQ} = \text{EDI} / \text{RfD}$$

Where:

HQ = Hazard quotient

EDI = Estimated daily intake (averaged over the exposure period) (mg/kg-day)

RfD = Reference dose (mg/kg-day)

HQs will be totaled to calculate HIs for each receptor scenario. HIs will be calculated for each exposure route and compound, and a total HI will be calculated based on all compounds and

exposure routes. In addition, HQs will be totaled for COPCs having the same target endpoint if the HI for the scenario exceeds one.

3.5 UNCERTAINTY ANALYSIS

The uncertainty analysis will present the major assumptions and uncertainties associated with the risk assessment, including general uncertainties associated with the risk assessment process, and site-specific uncertainties associated with the SMS Site. The predicted direction of each assumption or uncertainty on the evaluation of risk (i.e., overestimate, underestimate, or uncertain) will be indicated. The focus will be on those compounds and exposure pathways that pose a potential cancer risk of greater than 1-in-1 million (1E-06) or have a total hazard index of greater than one. Quantitative estimates of uncertainty (e.g., Monte Carlo simulation) will not be performed.

3.6 APPROACH FOR DEVELOPING PRGs

Risk-based PRGs will be calculated by medium (i.e., surface soil, surface/subsurface soil, groundwater, surface water, sediment) for those media found to pose a total cancer risk of greater than 1E-06, or have a hazard index of greater than one. If the same medium exceeds a benchmark criterion for more than one scenario, the PRGs will be based on the scenario with the highest cancer risk or hazard index to ensure that all potential receptors are protected. The scenario-specific exposure assumptions will be used in the calculations.

PRGs for each medium will be calculated based on the toxic endpoint(s) of concern (i.e., cancer and/or noncancer risk). If both cancer and noncancer benchmark criteria are exceeded for a medium, risk-based concentrations will be calculated based on both cancer and noncancer health effects, and the most conservative value for each compound will be selected as the PRG.

PRGs will be calculated for each compound in a medium based on total cancer risks of 1E-06 (1-in 1-million), 1E-05 (1-in-100,000), and 1E-04 (1-in-10,000) and on total hazard indices of 0.1, 1, and 3 (EPA, 1996a).

HUMAN HEALTH RISK ASSESSMENT

Because the cancer risk or hazard index for a compound is directly proportional to the exposure concentration, the following simplified equation will be used to calculate PRGs.

$$\text{PRG} = \frac{TL \times EC}{CR \text{ (or HI)}}$$

Where:

TL = Target Level (HI = 1 or 10 for noncarcinogenic effects and cancer risk = 1E-06, 1E-05 or 1E-04 for carcinogenic effects)

EC = Medium-Specific Exposure Concentration.

CR (or HI) = Cancer Risk or Hazard Index calculated based on the EC

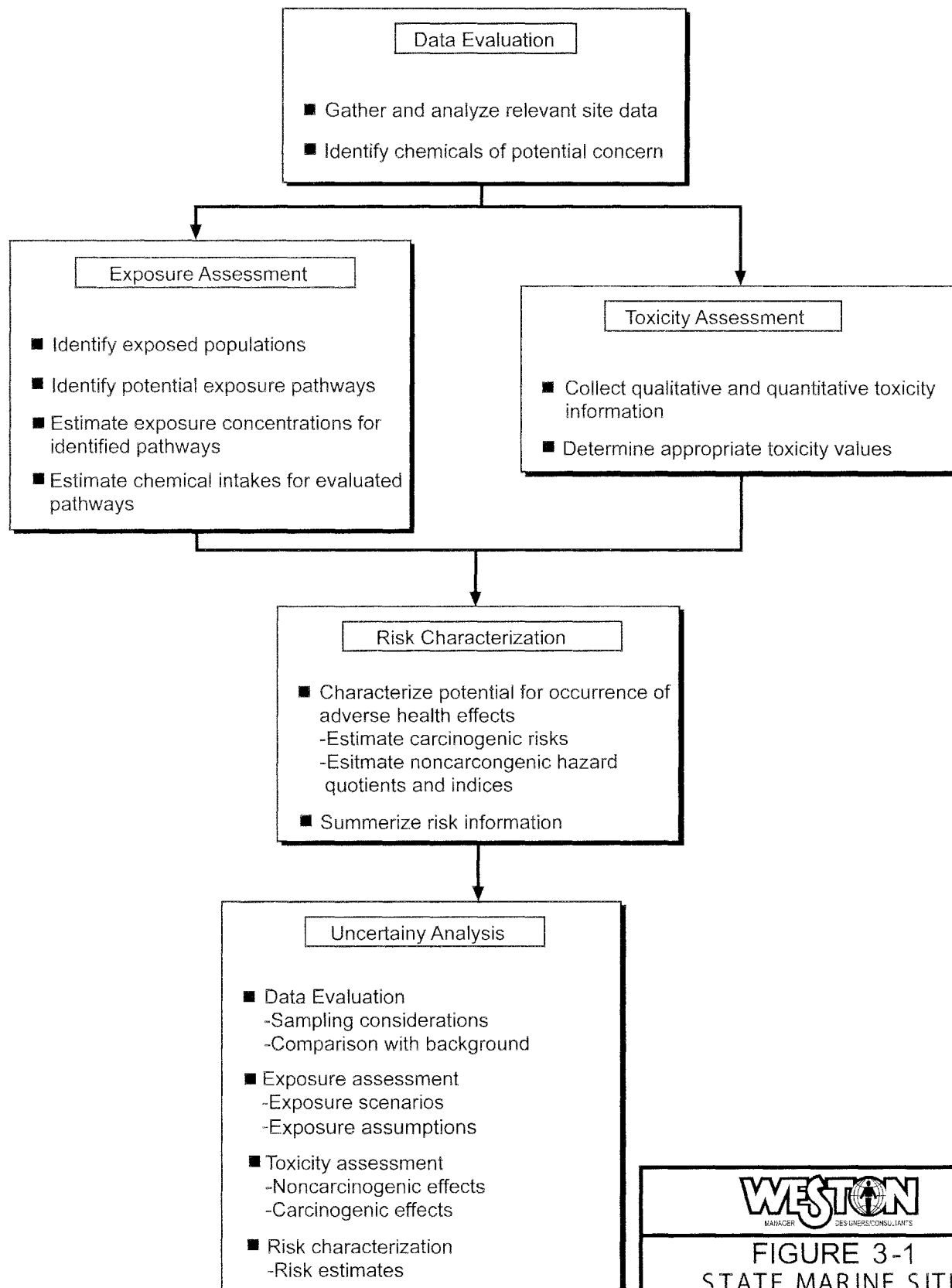


FIGURE 3-1
STATE MARINE SITE
US EPA REGION 6
 CERCLA ID NO. TXD099801102
SCHEMATIC OF THE HUMAN
HEALTH RISK ASSESSMENT
PROCESS FOR THE SITE
 PORT ARTHUR, JEFFERSON COUNTY, TEXAS

DATE
JAN 01

PROJECT NO.
20074.515.012

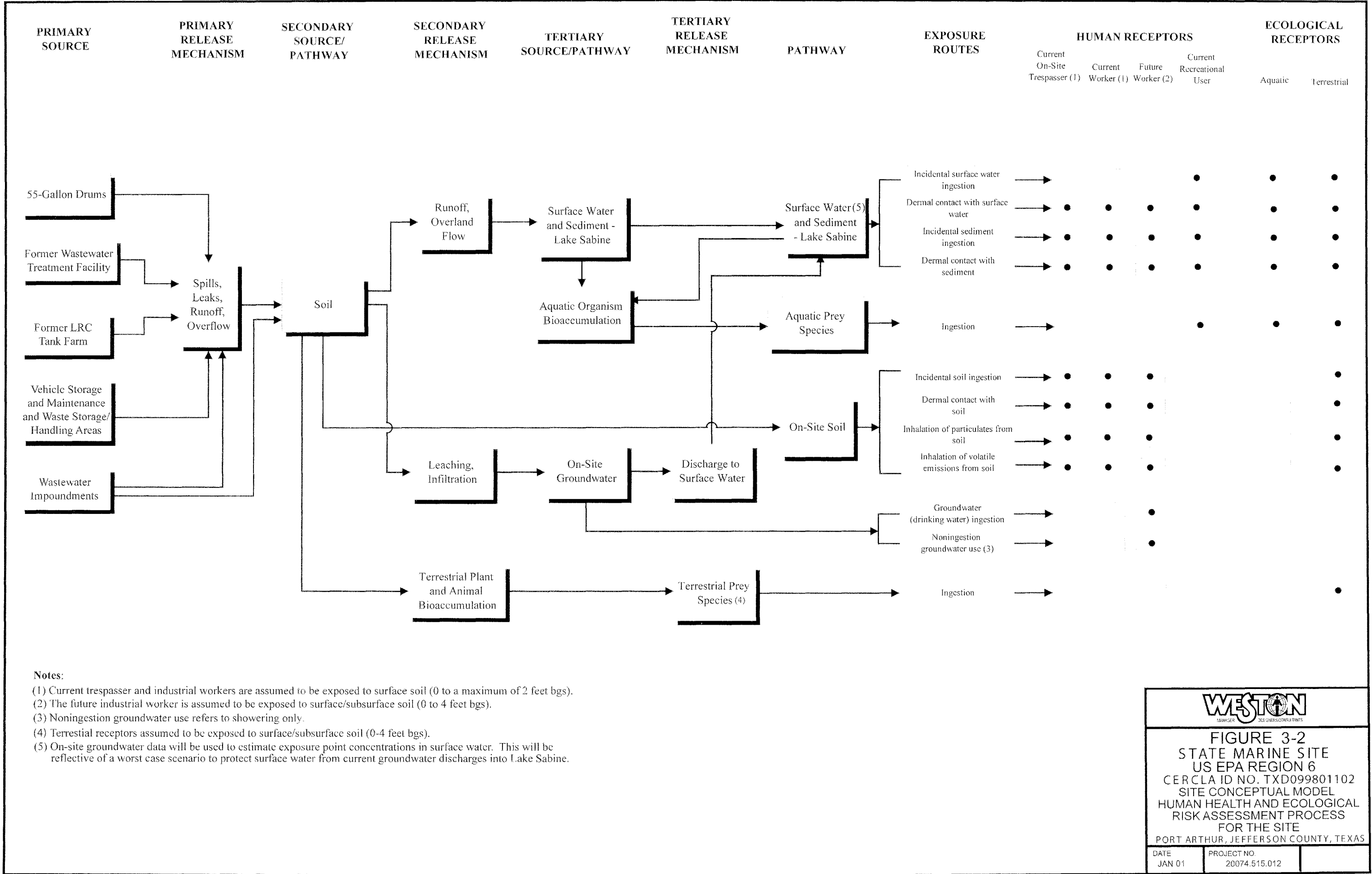


Table 3-1
Potential Exposure Pathways/Routes

EPS	Exposure Pathways	Scenarios	Receptors	Exposure Routes
1	On-Site Surface Soil	Current Use	RME - 7 to 18 year old trespasser CT - 7 to 18 year old trespasser	- Incidental ingestion - Dermal contact - Inhalation of particulates - Inhalation of volatiles ¹
	Sabine Lake Sediment	Current Use	RME - 7 to 18 year old trespasser CT - 7 to 18 year old trespasser	- Dermal contact - Incidental ingestion
	Sabine Lake Surface Water	Current Use	RME - 7 to 18 year old trespasser CT - 7 to 18 year old trespasser	- Dermal contact
2	On-Site Surface Soil	Current Use	RME - Industrial Worker CT - Industrial Worker	- Incidental ingestion - Dermal contact - Inhalation of particulates - Inhalation of volatiles ¹
	Sabine Lake Sediment	Current Use	RME - Industrial Worker CT - Industrial Worker	- Dermal contact - Incidental ingestion
	Sabine Lake Surface Water	Current Use	RME - Industrial Worker CT - Industrial Worker	- Dermal contact
3	On-Site Surface/ Subsurface Soil	Future Use	RME - Industrial Worker CT - Industrial Worker	- Incidental ingestion - Dermal contact - Inhalation of particulates - Inhalation of volatiles
	Sabine Lake Sediment	Future Use	RME - Industrial Worker CT - Industrial Worker	- Dermal contact - Incidental ingestion
	Sabine Lake Surface Water	Future Use	RME - Industrial Worker CT - Industrial Worker	- Dermal contact
	On-Site Groundwater	Future Use	RME - Industrial Worker CT - Industrial Worker	- Ingestion - Dermal contact while showering (showering scenario)
4	Sabine Lake Sediment	Current Use	RME - Recreational User CT - Recreational User	- Dermal contact ² - Incidental ingestion ²
	Sabine Lake Surface Water	Current Use	RME - Recreational User CT - Recreational User	- Dermal contact ² - Incidental ingestion ²
	Aquatic Prey Species	Current Use	RME - Recreational User CT - Recreational User	- Ingestion (fishing)

Notes:

¹ Inhalation of volatiles was evaluated only for the soil pathway. The soil depth interval used to evaluate inhalation was 0 feet to a maximum depth of 4 feet.

² Exposure route associated with contact during recreational swimming.

EPS = Exposure Pathway Scenario

RME = Reasonable Maximum Exposure

CT = Central Tendency

Table 3-2

Model For Calculating Doses From The Incidental Ingestion of On-Site Soil

$$\text{Dose from Soil Ingestion (mg/kg-day)} = \frac{CS \times IR \times CF \times EF \times ED}{BW \times AT}$$

Where:

CS	=	Chemical concentration in soil (mg/kg)
IR	=	Soil ingestion rate (mg/day)
CF	=	Conversion factor (kg/mg)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
BW	=	Body weight (kg)
AT	=	Averaging time (days)

Scenario Exposure Assumptions				
Parameter	Trespasser		Industrial Worker	
	CT	RME	CT	RME
CS	95% UCL in Soil	95% UCL in Soil	95% UCL in Soil	95% UCL in Soil
IR	100 mg/day (EPA, 1995)	100 mg/day (EPA, 1995)	50 mg/day (EPA, 1995)	50 mg/day (EPA, 1995)
CF	10 ⁻⁶ kg/mg	10 ⁻⁶ kg/mg	10 ⁻⁶ kg/mg	10 ⁻⁶ kg/mg
EF	30 days/year (estimated)	60 days/year (EPA, 1995)	250 days/year (EPA, 1995)	250 days/year (EPA, 1995)
ED	10 years (EPA, 1995)	10 years (EPA, 1995)	9 years (EPA, 1995)	25 years (EPA, 1995)
BW ¹	47 kg (EPA, 1997a)	47 kg (EPA, 1997a)	70 kg (EPA, 1995)	70 kg (EPA, 1995)
AT (noncancer)	10 years x 365 days/year (EPA, 1995)	10 years x 365 days/year (EPA, 1995)	9 years x 365 days/year (EPA, 1995)	25 years x 365 days/year (EPA, 1995)
AT (cancer)	70 years x 365 days/year (EPA, 1995)	70 years x 365 days/year (EPA, 1995)	70 years x 365 days/year (EPA, 1995)	70 years x 365 days/year (EPA, 1995)

¹ The body weight calculated for the recreational user was determined to be 47 kilograms based on the average body weight of boys and girls between the ages of 7 and 18 (EPA, 1997a)

Table 3-3

Model For Calculating Doses From Dermal Contact With On-Site Soil

Dose from Dermal Contact

$$\text{With Soil (mg/kg-day)} = \frac{CS \times SA \times CF \times AF \times ABS \times EF \times ED}{BW \times AT}$$

Where:

CS	=	Chemical concentration in soil, waste piles, or drums(mg/kg)
SA	=	Skin surface area available for contact (cm ² /day)
CF	=	Conversion factor (kg/mg)
AF	=	Soil-to-skin adherence factor (mg/cm ²)
ABS	=	Dermal absorption factor (unitless)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
BW	=	Body weight (kg)
AT	=	Averaging time (days)

Scenario Exposure Assumptions				
Parameter	Trespasser		Industrial Worker	
	CT	RME	CT	RME
CS	95% UCL in Soil	95% UCL in Soil	95% UCL in Soil	95% UCL in Soil
SA	3800 cm ² /day (EPA, 1997a)	4600 cm ² /day (EPA, 1997a)	5000 cm ² /day (EPA, 1992a)	5000 cm ² /day (EPA, 1992a)
CF	10 ⁻⁶ kg/mg	10 ⁻⁶ kg/mg	10 ⁻⁶ kg/mg	10 ⁻⁶ kg/mg
AF	0.2 mg/cm ² (EPA, 1995)	1 mg/cm ² (EPA, 1995)	0.2 mg/cm ² (EPA, 1995)	1 mg/cm ² (EPA, 1995)
ABS	Chemical-specific or Default Values (EPA, 1995): 0.1 - organics 0.01 - inorganics	Chemical-specific or Default Values (EPA, 1995): 0.1 - organics 0.01 - inorganics	Chemical-specific or Default Values (EPA, 1995): 0.1 - organics 0.01 - inorganics	Chemical-specific or Default Values (EPA, 1995): 0.1 - organics 0.01 - inorganics
EF	30 days/year (estimated)	60 days/year (EPA, 1995)	250 days/year (EPA, 1995)	250 days/year (EPA, 1995)
ED	10 years (EPA, 1995)	10 years (EPA, 1995)	9 years (EPA, 1995)	25 years (EPA, 1995)
BW	47 kg (EPA, 1997a)	47 kg (EPA, 1997a)	70 kg (EPA, 1995)	70 kg (EPA, 1995)
AT (noncancer)	10 years x 365 days/year (EPA, 1995)	10 years x 365 days/year (EPA, 1995)	9 years x 365 days/year (EPA, 1995)	25 years x 365 days/year (EPA, 1995)
AT (cancer)	70 years x 365 days/year (EPA, 1995)	70 years x 365 days/year (EPA, 1995)	70 years x 365 days/year (EPA, 1995)	70 years x 365 days/year (EPA, 1995)

¹ The body weight calculated for the recreational user was determined to be 47 kilograms based on the average body weight of boys and girls between the ages of 7 and 18 (EPA, 1997a).

Table 3-4

Model For Calculating Doses From The Inhalation of Particulates Released From On-Site Soil

Dose from Inhalation of Particulates

$$\text{Released from Soil/Waste Piles/Drums (mg/kg-day)} = \frac{CS \times IR \times (1/PEF) \times EF \times ED}{BW \times AT}$$

Where:

CS	=	Chemical concentration in soil, waste piles, or drums (mg/kg)
IR	=	Inhalation rate (m ³ /day)
PEF	=	Particulate emission factor (m ³ /kg)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
BW	=	Body weight (kg)
AT	=	Averaging time (days)

Scenario Exposure Assumptions				
Parameter	Trespasser		Industrial Worker	
	CT	RME	CT	RME
CS	95% UCL in Soil	95% UCL in Soil	95% UCL in Soil	95% UCL in Soil
IR	10 m ³ /day (estimated)	10 m ³ /day (estimated)	20 m ³ /day (estimated)	20 m ³ /day (EPA, 1991b)
PEF	1.32E+09 m ³ /kg (EPA, 1996)	1.32E+09 m ³ /kg (EPA, 1996)	1.32E+09 m ³ /kg (EPA, 1996)	1.32E+09 m ³ /kg (EPA, 1996)
EF	30 days/year (estimated)	60 days/year (EPA, 1995)	250 days/year (EPA, 1995)	250 days/year (EPA, 1995)
ED	10 years (EPA, 1995)	10 years (EPA, 1995)	9 years (EPA, 1995)	25 years (EPA, 1995)
BW	47 kg (EPA, 1997a)	47 kg (EPA, 1997a)	70 kg (EPA, 1995)	70 kg (EPA, 1995)
AT (noncancer)	10 years x 365 days/year (EPA, 1995)	10 years x 365 days/year (EPA, 1995)	9 years x 365 days/year (EPA, 1995)	25 years x 365 days/year (EPA, 1995)
AT (cancer)	70 years x 365 days/year (EPA, 1995)	70 years x 365 days/year (EPA, 1995)	70 years x 365 days/year (EPA, 1995)	70 years x 365 days/year (EPA, 1995)

¹ The body weight calculated for the recreational user was determined to be 47 kilograms based on the average body weight of boys and girls between the ages of 7 and 18 (EPA, 1997a).

Table 3-5

Model For Calculating Doses From The Inhalation of Volatiles Released From On-Site Soil

$$\text{Dose from Inhalation of Volatiles Released from Soil (mg/kg-day)} = \frac{CS \times IR \times (1/VF) \times EF \times ED}{BW \times AT}$$

Where:

CS	=	Chemical concentration in soil (mg/kg)
IR	=	Inhalation rate (m ³ /day)
VF	=	Soil-to-air volatilization factor (m ³ /kg)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
BW	=	Body weight (kg)
AT	=	Averaging time (days)

Scenario Exposure Assumptions				
Parameter	Trespasser		Industrial Worker	
	CT	RME	CT	RME
CS	95% UCL in Soil	95% UCL in Soil	95% UCL in Soil	95% UCL in Soil
IR	10 m ³ /day (estimated)	10 m ³ /day (estimated)	20 m ³ /day (estimated)	20 m ³ /day (EPA, 1991b)
VF	Chemical Specific	Chemical Specific	Chemical Specific	Chemical Specific
EF	30 days/year (estimated)	60 days/year (EPA, 1995)	250 days/year (EPA, 1995)	250 days/year (EPA, 1995)
ED	10 years (EPA, 1995)	10 years (EPA, 1995)	9 years (EPA, 1995)	25 years (EPA, 1995)
BW	47 kg (EPA, 1997a)	47 kg (EPA, 1997a)	70 kg (EPA, 1995)	70 kg (EPA, 1995)
AT (noncancer)	10 years x 365 days/year (EPA, 1995)	10 years x 365 days/year (EPA, 1995)	9 years x 365 days/year (EPA, 1995)	25 years x 365 days/year (EPA, 1995)
AT (cancer)	70 years x 365 days/year (EPA, 1995)	70 years x 365 days/year (EPA, 1995)	70 years x 365 days/year (EPA, 1995)	70 years x 365 days/year (EPA, 1995)

¹ The body weight calculated for the recreational user was determined to be 47 kilograms based on the average body weight of boys and girls between the ages of 7 and 18 (EPA, 1997a).

Table 3-6

Model For Calculating Doses From The Ingestion of On-Site Groundwater

$$\text{Dose from Groundwater Ingestion (mg/kg-day)} = \frac{CW \times IR \times EF \times ED}{BW \times AT}$$

Where:

CW	=	Chemical concentration in groundwater (mg/liter)
IR	=	Ingestion rate (liters/day)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
BW	=	Body weight (kg)
AT	=	Averaging time (days)

Scenario Exposure Assumptions		
Parameter	Industrial Worker	
	CT	RME
CW	Mean concentration in groundwater	Mean concentration in groundwater
IR	0.7 liter/day (EPA, 1995)	1 liter/day (EPA, 1995)
EF	250 days/year (EPA, 1995)	250 days/year (EPA, 1995)
ED	9 years (EPA, 1995)	25 years (EPA, 1995)
BW	70 kg (EPA, 1995)	70 kg (EPA, 1995)
AT (noncancer)	9 years x 365 days/year (EPA, 1995)	25 years x 365 days/year (EPA, 1995)
AT (cancer)	70 years x 365 days/year (EPA, 1995)	70 years x 365 days/year (EPA, 1995)

Table 3-7

Model For Calculating Doses From Dermal Contact While Showering

$$\text{Dermal Absorption Dose from Showering (mg/kg-day)} = \frac{CW \times CF \times SA \times PC \times ET \times EF \times ED}{BW \times AT}$$

Where:

CW	=	Chemical concentration in groundwater (mg/liter)
CF	=	Conversion factor (liters/cm ³)
SA	=	Skin surface area available for contact (cm ²)
PC	=	Dermal permeability coefficient (cm/hour)
ET	=	Exposure time (hours/day)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
BW	=	Body weight (kg)
AT	=	Averaging time (days)

Scenario Exposure Assumptions		
Industrial Worker		
Parameter	CT	RME
CW	Mean concentration in groundwater	Mean concentration in groundwater
CF	10 ⁻³ liters/cm ³ (EPA, 1995)	10 ⁻³ liters/cm ³ (EPA, 1995)
SA	20,000 cm ² /day (EPA, 1995)	20,000 cm ² /day (EPA, 1995)
PC	Chemical-specific	Chemical-specific
ET	0.12 hours/day (EPA, 1989a)	0.2 hours/day (EPA, 1995)
EF	250 days/year (EPA, 1995)	250 days/year (EPA, 1995)
ED	9 years (EPA, 1995)	25 years (EPA, 1995)
BW	70 kg (EPA, 1995)	70 kg (EPA, 1995)
AT (noncancer)	9 years x 365 days/year (EPA, 1995)	25 years x 365 days/year (EPA, 1995)
AT (cancer)	70 years x 365 days/year (EPA, 1995)	70 years x 365 days/year (EPA, 1995)

Table 3-8

Model For Calculating Doses From The Inhalation of Volatiles While Showering

$$\text{Dose from Inhalation of Volatiles while Showering (mg/kg-day)} = \frac{CW \times K \times IIR \times ET \times EF \times ED}{BW \times AT}$$

Where:

CW	=	Chemical concentration in groundwater (mg/liter)
K	=	Volatilization factor (liter/m ³)
IIR	=	Inhalation rate while showering (m ³ /hour)
ET	=	Exposure time (hours/day)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
BW	=	Body weight (kg)
AT	=	Averaging time (days)

Scenario Exposure Assumptions		
Industrial Worker		
Parameter	CT	RME
CW	Mean concentration in groundwater	Mean concentration in groundwater
K	0.0005 x 1000 liters/m ³ (EPA, 1995)	0.0005 x 1000 liters/m ³ (EPA, 1995)
IIR	0.6 m ³ /hour (EPA, 1989)	0.6 m ³ /hour (EPA, 1989a)
ET	0.12 hours/day (EPA, 1989a)	0.2 hours/day (EPA, 1995)
EF	250 days/year (EPA, 1995)	250 days/year (EPA, 1995)
ED	9 years (EPA, 1995)	25 years (EPA, 1995)
BW	70 kg (EPA, 1995)	70 kg (EPA, 1995)
AT (noncancer)	9 years x 365 days/year (EPA, 1995)	25 years x 365 days/year (EPA, 1995)
AT (cancer)	70 years x 365 days/year (EPA, 1995)	70 years x 365 days/year (EPA, 1995)

Table 3-9

Model For Calculating Doses From Ingestion of Surface Water While Swimming

$$\text{Dose from Surface Water Ingestion (mg/kg-day)} = \frac{CW \times IR \times ET \times EF \times ED}{BW \times AT}$$

Where:

CW	=	Chemical concentration in surface water (mg/liter)
IR	=	Ingestion rate (liters/hour)
ET	=	Exposure time (hours/event)
EF	=	Exposure frequency (events/year)
ED	=	Exposure duration (years)
BW	=	Body weight (kg)
AT	=	Averaging time (days)

Scenario Exposure Assumptions		
Recreational User		
Parameter	CT	RME
CW	95% UCL in Surface Water	95% UCL in Surface Water
IR	0.05 liters/hour (EPA, 1989a)	0.05 liters/hour (EPA, 1989a)
ET	1 hour/day (EPA, 1997a)	1 hour/day (EPA, 1997a)
EF	12 days/year (EPA, 1997a)	12 days/year (EPA, 1997a)
ED	10 years (estimated)	10 years (estimated)
BW ¹	47 kg (EPA, 1997a)	47 kg (EPA, 1997a)
AT (noncancer)	10 years x 365 days/year (EPA, 1995)	10 years x 365 days/year (EPA, 1995)
AT (cancer)	70 years x 365 days/year (EPA, 1995)	70 years x 365 days/year (EPA, 1995)

¹ The body weight calculated for the recreational user was determined to be 47 kilograms based on the average body weight of boys and girls between the ages of 7 and 18 (EPA, 1997a).

Table 3-10

Model For Calculating Doses From Dermal Contact With Surface Water

$$\text{Dermal Absorption Dose from Surface Water (mg/kg-day)} = \frac{CW \times CF \times SA \times PC \times ET \times EF \times ED}{BW \times AT}$$

Where:

CW	=	Chemical concentration in surface water (mg/liter)
CF	=	Conversion factor (liters/cm ³)
SA	=	Skin surface area available for contact (cm ²)
PC	=	Dermal permeability coefficient (cm/hour)
ET	=	Exposure time (hours/day)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
BW	=	Body weight (kg)
AT	=	Averaging time (days)

Parameter	Scenario Exposure Assumptions					
	Industrial Worker		Trespasser		Recreational User	
	CT	RME	CT	RME	CT	RME
CW	95% UCL in Surface Water	95% UCL in Surface Water	95% UCL in Surface Water	95% UCL in Surface Water	95% UCL in Surface Water	95% UCL in Surface Water
CF	10 ⁻³ liters/cm ³	10 ⁻³ liters/cm ³	10 ⁻³ liters/cm ³	10 ⁻³ liters/cm ³	10 ⁻³ liters/cm ³	10 ⁻³ liters/cm ³
SA	5000 cm ² (EPA, 1995)	5000 cm ² (EPA, 1995)	3800 cm ² (EPA, 1997a)	4600 cm ² (EPA, 1997a)	15,000 cm ² (EPA, 1997a)	18,500 cm ² (EPA, 1997a)
PC	Chemical-specific	Chemical-specific	Chemical-specific	Chemical-specific	Chemical-specific	Chemical-specific
ET	0.5 hours/day (estimated)	1.0 hours/day (estimated)	1.3 hours/day (estimated)	2.6 hours/day (EPA, 1995)	1 hour/day (EPA, 1997a)	1 hour/day (EPA, 1997a)
EF	100 days/year (estimated)	100 days/year (estimated)	30 days/year (estimated)	60 days/year (EPA, 1995)	12 days/year (EPA, 1997a)	12 days/year (EPA, 1997a)
ED	9 years (EPA, 1995)	25 years (EPA, 1995)	10 years (estimated)	10 years (EPA, 1995)	10 years (estimated)	10 years (estimated)
BW ¹	70 kg (EPA, 1995)	70 kg (EPA, 1995)	47 kg (EPA, 1997a)	47 kg (EPA, 1997a)	47 kg (EPA, 1997a)	47 kg (EPA, 1997a)

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Table 3-10 (Continued)

Model For Calculating Doses From Dermal Contact With Surface Water

Parameter	Scenario Exposure Assumptions					
	Industrial Worker		Trespasser		Recreational User	
	CT	RME	CT	RME	CT	RME
AT (noncancer)	9 years x 365 days/year (EPA, 1995)	25 years x 365 days/year (EPA, 1995)	10 years x 365 days/year (EPA, 1995)	10 years x 365 days/year (EPA, 1995)	10 years x 365 days/year (EPA, 1995)	10 years x 365 days/year (EPA, 1995)
AT (cancer)	70 years x 365 days/year (EPA, 1995)	70 years x 365 days/year (EPA, 1995)	70 years x 365 days/year (EPA, 1995)	70 years x 365 days/year (EPA, 1995)	70 years x 365 days/year (EPA, 1995)	70 years x 365 days/year (EPA, 1995)

¹ The body weight calculated for the recreational user was determined to be 47 kilograms based on the average body weight of boys and girls between the ages of 7 and 18 (EPA, 1997a).

Table 3-11

Model For Calculating Doses From The Incidental Ingestion Of Sediment

$$\text{Dose from Sediment Ingestion (mg/kg-day)} = \frac{CS \times IR \times CF \times EF \times ED}{BW \times AT}$$

Where:

CS	=	Chemical concentration in sediment (mg/kg)
IR	=	Sediment ingestion rate (mg/day)
CF	=	Conversion factor (kg/mg)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
BW	=	Body weight (kg)
AT	=	Averaging time (days)

Parameter	Scenario Exposure Assumptions					
	Industrial Worker		Trespasser		Recreational User	
	CT	RME	CT	RME	CT	RME
CS	95% UCL in Sediment	95% UCL in Sediment	95% UCL in Sediment	95% UCL in Sediment	95% UCL in Sediment	95% UCL in Sediment
IR	50 mg/day (estimated)	50 mg/day (EPA, 1995)	100 mg/day (estimated)	100 mg/day (EPA, 1995)	100 mg/day (estimated)	100 mg/day (estimated)
CF	10 ⁻⁶ kg/mg	10 ⁻⁶ kg/mg	10 ⁻⁶ kg/mg	10 ⁻⁶ kg/mg	10 ⁻⁶ kg/mg	10 ⁻⁶ kg/mg
EF	100 days/year (estimated)	100 days/year (estimated)	30 days/year (estimated)	60 days/year (EPA, 1995)	12 days/year (EPA, 1997a)	12 days/year (EPA, 1997a)
ED	9 years (EPA, 1995)	25 years (EPA, 1995)	10 years (estimated)	10 years (EPA, 1995)	10 years (estimated)	10 years (estimated)
BW ¹	70 kg (EPA, 1995)	70 kg (EPA, 1995)	47 kg (EPA, 1997a)	47 kg (EPA, 1997a)	47 kg (EPA, 1997a)	47 kg (EPA, 1997a)
AT (noncancer)	9 years x 365 days/year (EPA, 1995)	25 years x 365 days/year (EPA, 1995)	10 years x 365 days/year (EPA, 1995)	10 years x 365 days/year (EPA, 1995)	10 years x 365 days/year (EPA, 1995)	10 years x 365 days/year (EPA, 1995)

Table 3-11 (Continued)

Model For Calculating Doses From The Incidental Ingestion Of Sediment

Parameter	Scenario Exposure Assumptions					
	Industrial Worker		Trespasser		Recreational User	
	CT	RME	CT	RME	CT	RME
AT (cancer)	70 years x 365 days/year (EPA, 1995)	70 years x 365 days/year (EPA, 1995)	70 years x 365 days/year (EPA, 1995)	70 years x 365 days/year (EPA, 1995)	70 years x 365 days/year (EPA, 1995)	70 years x 365 days/year (EPA, 1995)

¹ The body weight calculated for the recreational user was determined to be 47 kilograms based on the average body weight of boys and girls between the ages of 7 and 18 (EPA, 1997a).

Table 3-12

Model For Calculating Doses From Dermal Contact With Sediment

$$\text{Dermal Absorption Dose from Sediment (mg/kg-day)} = \frac{CS \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

Where:

CS	=	Chemical concentration in sediment (mg/kg)
CF	=	Conversion factor (kg/mg)
SA	=	Skin surface area available for contact (cm ² /day)
AF	=	Sediment-to-skin adherence factor (mg/cm ²)
ABS	=	Dermal absorption factor (unitless)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
BW	=	Body weight (kg)
AT	=	Averaging time (days)

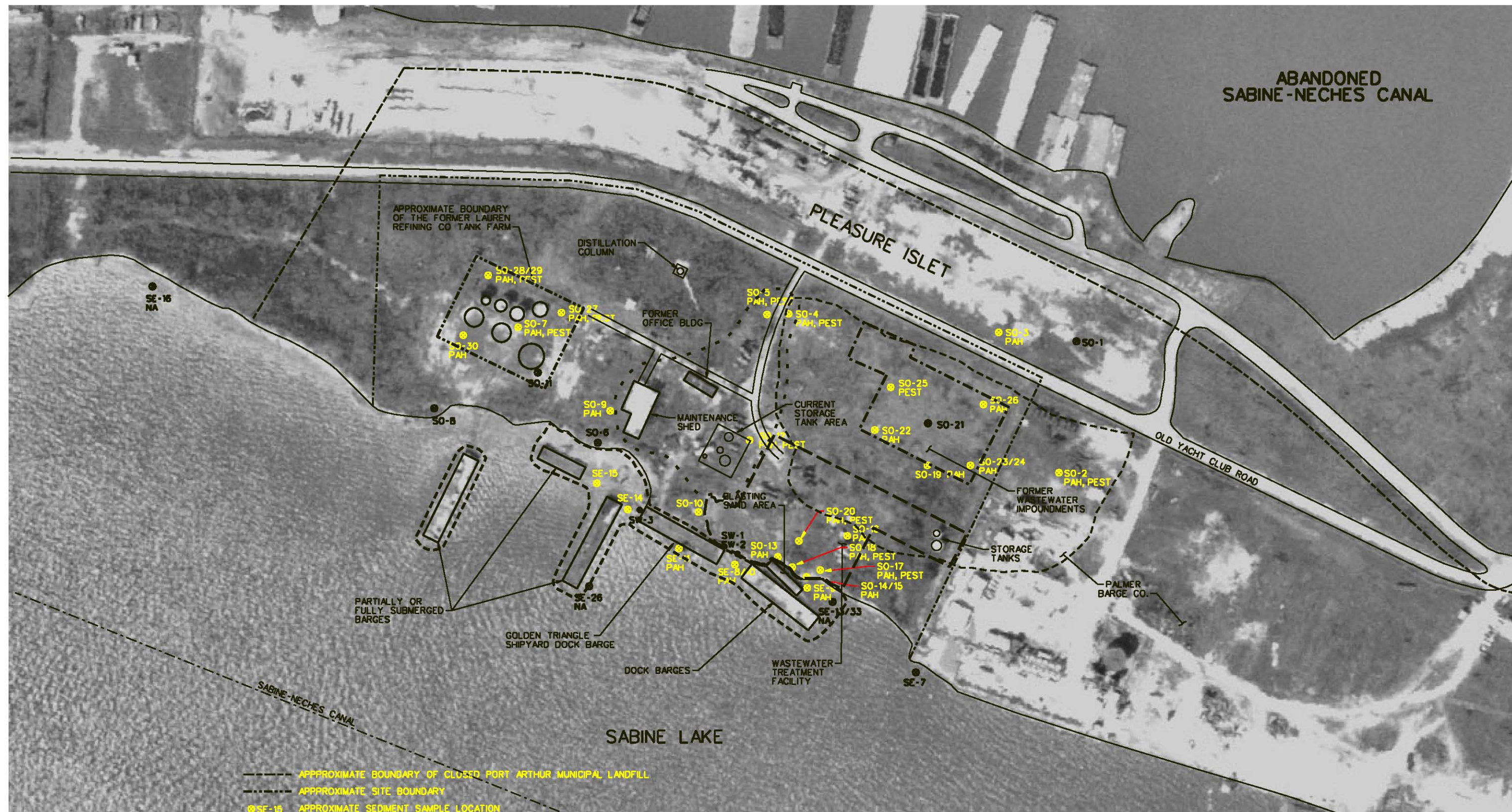
Scenario Exposure Assumptions							
Parameter	Industrial Worker		Trespasser		Recreational User		
	CT	RME	CT	RME	CT	RME	
CS	95% UCL in Sediment	95% UCL in Sediment	95% UCL in Sediment	95% UCL in Sediment	95% UCL in Sediment	95% UCL in Sediment	
CF	10 ⁻⁶ kg/mg	10 ⁻⁶ kg/mg	10 ⁻⁶ kg/mg	10 ⁻⁶ kg/mg	10 ⁻⁶ kg/mg	10 ⁻⁶ kg/mg	
SA	5000 cm ² /day (estimated)	5000 cm ² /day (estimated)	3800 cm ² /day (EPA, 1997a)	4600 cm ² /day (EPA, 1997a)	3800 cm ² /day (EPA, 1997a)	4600 cm ² /day (EPA, 1997a)	
AF	0.2 mg/cm ² (EPA, 1992a)	1 mg/cm ² (EPA, 1992a)	0.2 mg/cm ² (EPA, 1992a)	1 mg/cm ² (EPA, 1992a)	0.2 mg/cm ² (EPA, 1992a)	1 mg/cm ² (EPA, 1992a)	

Table 3-12 (Continued)

Model for Calculating Doses From Dermal Contact With Sediment

Parameter	Scenario Exposure Assumptions					
	Industrial Worker		Trespasser		Recreational User	
	CT	RME	CT	RME	CT	RME
ABS	Chemical-specific or Default Values (EPA, 1995): 0.1 - organics 0.01 - inorganics	Chemical-specific or Default Values (EPA, 1995): 0.1 - organics 0.01 - inorganics	Chemical-specific or Default Values (EPA, 1995): 0.1 - organics 0.01 - inorganics	Chemical-specific or Default Values (EPA, 1995): 0.1 - organics 0.01 - inorganics	Chemical-specific or Default Values (EPA, 1995): 0.1 - organics 0.01 - inorganics	Chemical-specific or Default Values (EPA, 1995): 0.1 - organics 0.01 - inorganics
EF	100 days/year (estimated)	100 days/year (estimated)	30 days/year (estimated)	60 days/year (EPA, 1995)	12 days/year (EPA, 1997a)	12 days/year (EPA, 1997a)
ED	9 years (EPA, 1995)	25 years (EPA, 1995)	10 years (estimated)	10 years (EPA, 1995)	10 years (estimated)	10 years (estimated)
BW ¹	70 kg (EPA, 1995)	70 kg (EPA, 1995)	47 kg (EPA, 1997a)	47 kg (EPA, 1997a)	47 kg (EPA, 1997a)	47 kg (EPA, 1997a)
AT (noncancer)	9 years x 365 days/year (EPA, 1995)	25 years x 365 days/year (EPA, 1995)	10 years x 365 days/year (EPA, 1995)	10 years x 365 days/year (EPA, 1995)	10 years x 365 days/year (EPA, 1995)	10 years x 365 days/year (EPA, 1995)
AT (cancer)	70 years x 365 days/year (EPA, 1995)	70 years x 365 days/year (EPA, 1995)	70 years x 365 days/year (EPA, 1995)	70 years x 365 days/year (EPA, 1995)	70 years x 365 days/year (EPA, 1995)	70 years x 365 days/year (EPA, 1995)

¹ The body weight calculated for the recreational user was determined to be 47 kilograms based on the average body weight of boys and girls between the ages of 7 and 18 (EPA, 1997a).



- APPROXIMATE BOUNDARY OF CLOSED PORT ARTHUR MUNICIPAL LANDFILL
- APPROXIMATE SITE BOUNDARY
- SE-15 APPROXIMATE SEDIMENT SAMPLE LOCATION
- SO-25 APPROXIMATE SOIL SAMPLE LOCATION
- ▲ SW-3 APPROXIMATE SURFACE WATER SAMPLE LOCATION
- PAH SAMPLE CONTAINS AT LEAST ONE POLYNUCLEAR AROMATIC HYDROCARBON (PAH) OCCURRING AT CONCENTRATIONS EXCEEDING PRG
- PEST SAMPLE CONTAINS AT LEAST ONE PESTICIDE AND/OR POLYCHLORINATED BIPHENYL (PCB) OCCURRING AT CONCENTRATIONS EXCEEDING PRG
- 1 ALL SAMPLES CONTAINED AT LEAST ONE EXCEEDANCE FOR METALS
- NA SAMPLE NOT ANALYZED FOR PAH's OR PEST

FIGURE 3-2
DISTRIBUTION OF SAMPLES CONTAINING
1 ORGANIC COMPOUNDS THAT EXCEED PRG
 STATE MARINE SUPERFUND SITE, PORT ARTHUR, TEXAS
 RI/FS TECHNICAL MEMORANDUM

4. ECOLOGICAL RISK ASSESSMENT

4.1 INTRODUCTION

This section provides an overview of the methods to be used in conducting the screening-level ecological risk assessment for the on-site and off-site areas of SMS Site. Further information on the site location and history is presented in Section 2 of the RI/FS TWP. Because of limitations in funding, the ecological risk assessment will be split into two phases of work. The first phase (Phase 1) will be limited to a conservative screening-level risk assessment and summary of ecological habitat and potential receptors including identification of sensitive habitat and species of special concern. The second phase (Phase 2), if implemented, will be a more involved baseline risk assessment including a problem formulation, study design, and site investigation and data analysis (EPA, 1997d). The results of this screening-level risk assessment will indicate the need for implementation of a baseline ecological risk assessment.

The current work plan includes information that is pertinent only to the successful completion of Phase 1 of the ecological risk assessment. Information pertinent to the completion of Phase 2 will be presented, if necessary, under separate cover including a work plan and baseline risk assessment report.

4.2 ECOLOGICAL RISK ASSESSMENT PROCESS

EPA guidance (EPA, 1997d) defines ecological risk assessment for the Superfund Program as a “qualitative and/or quantitative appraisal of the actual or potential impacts of compounds from a hazardous waste site on plants and animals other than humans and domesticated species.” An ecological risk assessment can involve up to 8-steps in the process. These steps are presented in Figure 3-1 (an 8-Step Ecological Risk Assessment Process for Superfund).

The methods that will be used to conduct this screening-level ecological risk assessment incorporate a “desk-top” approach to evaluating ecological risk (see Steps 1 and 2), including a conservative screening of compounds against ecotoxicity or screening benchmarks values

(SBVs). The methods that describe site-specific field studies that may be considered as part of a baseline ecological risk assessment (Steps 3 through 8) will be presented, if necessary, under separate cover as part of Phase 2. A summary of all the components of the ecological risk assessment process, including the screening-level, are illustrated in Figure 3-2 (Framework for Ecological Risk Assessment).

The primary guidance documents that will be used in conducting the screening-level ecological risk assessment include:

- *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments* (EPA, 1997d)
- *Framework for Ecological Risk Assessment* (EPA, 1992d)
- *Guidance for Data Usability in Risk Assessment* (EPA, 1992c and 1992f)
- *Draft Ecological Soil Screening Level Guidance* (EPA, 2000)
- *Guidance for Conducting Ecological Risk Assessments at Remediation Sites in Texas* (TNRCC, 2000)

The ecological risk assessment will be organized into the following sections:

- Data Evaluation and Reduction
- Ecological Receptors and Habitat
- Exposure Characterization
- Screening Benchmark Values
- Risk Screening

Each of the above components are discussed in more detail in the sections that follow.

4.3 DATA EVALUATION AND REDUCTION

The objectives of the ecological data evaluation and reduction process will be to review and summarize the SMS Site analytical database and reduce unuseable data appropriately. The combination of current and historical data is discussed under Data Useability (Section 2.1.3).

ECOLOGICAL RISK ASSESSMENT

Data summaries for historical data and the rules for general data useability for the risk assessment are presented in Section 2. Data evaluation and reduction specific to the ecological risk assessment is summarized below.

All useable on-site (uplands) and off-site (aquatic) sampling data will be reviewed for each medium and the adequacy of detection limits from an ecological basis assessed. Media that will be evaluated in the ecological risk assessment includes groundwater, soils, sediment, and surface water. Compound concentrations in surface water in Sabine Lake currently represent a data gap and will be collected from locations in the nearshore zone to support the ecological risk assessment. Groundwater data were collected from previous investigations using Geoprobe techniques and are not appropriate for use in quantitative risk assessment. However, groundwater data to be obtained from monitoring wells proposed as part of the RI/FS in the upland areas adjacent to Lake Sabine will be evaluated in the risk assessment. Screening of groundwater from these wells will be used as tool for predicting potential discharge impacts to Lake Sabine surface water. All data collected as part of the RI/FS field work will be included in a final data summary and will incorporate the general data reduction rules as outlined in Section 2.1.3.

A list of compounds will be summarized from the complete set of analytical data from both historical and current sampling events using the following criteria:

- A compound will be excluded from a medium if it is not detected in any sample from that medium. It should be noted, however, that the adequacy of the detection limits for detected and non-detected compounds will be evaluated in the risk assessment as part of the ecological data evaluation and reduction process. Compounds whose detection limits exceed the ecological SBVs will be identified as a potential data gap and subject to further evaluation.
- Compounds that are infrequently detected may be artifacts in the data due to sampling, analytical, or other errors. Assuming that detection limits meet ecological-based project required quantitation limits and that adequate sampling has occurred, compounds detected in

less than five percent of the samples site-wide for a given medium will be excluded from that medium.

4.3.1 Background Evaluation

On- and off-site concentrations of inorganic compounds will be qualitatively and quantitatively compared with ambient or background concentrations sampled on or adjacent to SMS to determine which site-specific inorganic compounds may or may not be significantly different from ambient levels. Because EPA Region 6 does not allow for elimination of inorganic compounds based on background levels there will be no elimination of inorganics from the actual quantitative screening. Although inorganic COPECs that are equivalent to ambient concentrations will not be eliminated, the risks associated with compounds similar to ambient concentrations will be considered separately and discussed further in an analysis of ambient levels.

Inorganic compounds that are considered essential nutrients (calcium, iron, potassium, magnesium, and sodium) with low toxicities will not be evaluated unless extreme concentrations are encountered that indicate potential toxicological hazard.

4.4 ECOLOGICAL RECEPTORS AND HABITAT

The ecological receptor and habitat characterization will involve the refinement of habitat and receptors that have been already summarized in this work plan. The characterization will focus on a “literature” study of existing information and a discussion of receptors (and their life histories) that are likely to be found and potentially exposed to compounds in on- and off-site areas of the SMS Site. The refinement of receptors and habitat provides justification to the screening of site data with media-specific SBVs.

4.4.1 Characterization of Habitat

The characterization of habitat, including habitat critical to receptors on and around the SMS Site, provides additional ecological background for the ecological report and will work to refine the habitat information provided below.

The Palmer and State Marine sites sit on a man-made land mass (Pleasure Islet) that was created over a 20-year period at the turn of the 20th century by disposal of landfill wastes from the local community of Port Arthur and materials dredged during the construction of the Sabine-Neches Canal. The islet that was formed was isolated from the mainland until a land bridge was constructed in the mid to late 1950s. The islet remained undeveloped until the construction of the land bridge. The original landscape was heavily vegetated with shrub/scrub type vegetation. Similar vegetation exists on the islet today in areas that remain undeveloped. The upland portion of the Palmer site is representative of disturbed habitat and includes larger grassy areas with some shrubs and small trees. Significant portions of the site have been cleared and graveled or are developed with buildings and tanks and other facilities.

The soils on the island are shallow (0 to 4 feet) and reflect the nature of the sediments dredged from Sabine Lake as primarily sandy silts and clays. The central portion of the islet including the entire Palmer site is underlain by a municipal landfill that extends to within 2 feet of the land surface. In addition, the southwest portion of the Palmer site and the northwest portion of the State Marine property is the historical location of the landfill burn pit. Shallow groundwater occurs close to the land surface and may be brackish, which would limit the development of larger trees or deep-rooted plant communities.

The Palmer site shoreline has been heavily modified by construction of a bulkhead that forms the outer edge of a pier that runs along most of the property boundary. A small portion of the southeastern shoreline retains some natural features. The SMS shoreline varies; some natural shoreline exists in the northern and southern portions of the property. The central area appears to be the most heavily modified by the presence of piers, slips, and other structures. A number of sunken barges are also present in the nearshore area.

Sabine Lake bounds the eastern side of the Palmer site and represents over 90,000 acres of ecologically important estuarine and wetland habitat. The majority of the bottom sediments are anticipated to be fine-grained with high organic content.

4.4.2 Identification of Ecological Receptors

A preliminary identification of ecological receptors at the SMS Site is presented below. No species inventories currently exist. However, the upland areas are expected to support small populations of rodents and other small mammals (e.g., opossum, rabbit, raccoon, skunk, vole), birds (e.g., song, raptor, shore), and reptiles (snakes, turtles). Amphibian use is unknown. Insects and other invertebrates are also expected to be abundant; however, it is unknown how well developed populations of soil invertebrates are, given the estuarine source of the soil.

Sabine Lake supports significant populations of recreationally important species including oysters, shrimp, blue crab, drum, red snapper, speckled trout, flounder, kingfish, amberjack, and shark. Sabine Lake and its extensive wetland system also supports a large number of migratory bird species on a seasonal basis. Over 290 species of birds occur within the State of Texas, with many species utilizing the coastal plains and wetland habitats.

In addition, a number of federally endangered or threatened species may occur in the area. These species are discussed in greater detail in the following section.

4.4.2.1 Endangered, Threatened, and Rare Species

Over 150 federally or state-listed threatened and endangered species of plants, insects, birds, mammals, fish, and reptiles occur within the State of Texas. According to the TNRCC, a number of federal and state threatened or endangered species have been identified as having habitat within a 4-mile radius or within 15 miles downstream of the site. Table 3-1 summarizes this list of state and federal threatened and endangered species that may occur in the vicinity of the site. Possible occurrence does not confirm that a species is present nor does it preclude other threatened and/or endangered species that are not listed from utilizing habitats within the vicinity of the site.

4.5 EXPOSURE CHARACTERIZATION

The exposure characterization identifies the potential magnitude and frequency by which compounds have migrated through various pathways and may be exposed to organisms identified in terrestrial and aquatic habitat adjacent to the SMS Site.

4.5.1 Identification of Exposure Pathways

An exposure pathway describes the course a compound takes from its source to an ecological receptor. An exposure pathway generally consists of 4 elements: (1) a source and mechanism of release, (2) a retention or transport medium, (3) a point of contact with the receptor, and (4) an exposure route (e.g., ingestion) at the point of contact.

Exposure pathways for ecological receptors at the SMS Site will be identified by medium (i.e., soils, surface water, sediment), and briefly discussed in relation to the fate and transport properties of the compounds. A preliminary conceptual site model (CSM) is presented in Figure 2-2. It is expected that various birds, mammals, and aquatic receptors have the potential to be exposed to compounds at the SMS Site. A refined list of preliminary receptors (including T&E species) potentially at risk from exposure to contamination will be presented in the screening risk assessment after a more specific literature-based survey of the site has been completed. This will form the basis for a site-specific food web model that may be developed as part of Phase 2 of the ecological risk assessment.

4.5.2 Exposure Point Concentrations

Once potential exposure pathways and affected habitats have been defined and the potential receptors identified, points of likely exposure will be estimated. The compound concentrations at these contact points (i.e., exposure point concentrations) are critical in determining exposure and subsequent risk to receptors.

4.5.2.1 On-Site Areas

Exposure point concentrations will be developed for the uplands areas of the SMS Site, taking into account potential “hot spots” of contamination. The term “hot spot” is used to describe a localized area where one or more compounds occur in concentrations substantially (e.g., 2 or more orders of magnitude) greater than those found elsewhere in the remainder of the site. The identification of hot spots will be determined on a case-by-case basis depending on the findings of the RI/FS source area evaluation.

Potential on-site impacts to ecological receptors will be assessed in the screening-level ecological risk assessment using two exposure point concentrations—the maximum detected and the 95% upper confidence limit (UCL) concentration of the mean. If the 95% UCL concentration exceeds the maximum detected concentration for a compound, the maximum detected concentration will be used as the exposure point concentration. For those organisms that are stationary or are not very mobile (e.g., plants, soil invertebrates), the maximum detected concentration is most applicable as the exposure point concentration. The 95% UCL concentration is more applicable to those organisms that are mobile and may be exposed to a larger portion of the site. Both sets of concentrations will be applied in this screening-level assessment.

4.5.2.2 Off-Site Areas

There is limited off-site data that currently exists for the SMS Site, representing a data gap that will be filled during the RI/FS field investigation. See the Off-Site Field Sampling Plan in Appendix E for more details.

Potential impact to birds, mammals, and aquatic receptors directly exposed to surface water or sediment in Sabine Lake will be evaluated in the screening-level risk assessment using two exposure point concentrations; the maximum detected and the 95% UCL concentrations. The maximum concentration is most applicable to those situations in which a species is not as mobile (e.g., benthic macroinvertebrates) and may be exposed to a localized area. The 95% UCL is most applicable to those organisms that are more mobile (e.g., birds and mammals) and may be

exposed to a larger segment of the off-site area. If the 95% UCL concentration exceeds the maximum detected concentration for a compound, only the maximum detected concentration will be used as an exposure point concentration for that contaminant.

4.6 SCREENING BENCHMARK VALUES

Ecological Soil Screening Level Guidance (EPA, 2000) and *Guidance for Conducting Ecological Risk Assessments at Remediation Sites in Texas* (TNRCC, 2000) will be used for developing SBVs in this screening-level risk assessment. For compounds where values from these guidance documents do not exist, SBVs based on alternate literature or generally acceptable risk-based approaches will be used where appropriate. A combination of the lowest SBVs that are available for a particular media will be used in evaluating the acceptability of detection limits, and determining PRGs for the ecological assessment for each detected compound in each medium. Information regarding detection limits, including project required detection limits (PRQLs) for each medium, are presented in the Quality Assurance Project Plan (Appendix C).

If a media- and receptor-specific SBV is not available for a given compound, and one cannot be derived, that compound will be identified and retained for further discussion as a potential “data gap” in the risk assessment.

4.6.1.1 Soil

Soil SBVs will be based on the lowest available values for each category of receptor (i.e., birds, mammals, plants, invertebrates). SBVs for birds and mammals that are not available from the TNRCC (2000) or EPA (2000) will be estimated using the general equation as outlined below. Soil SBVs for plant and invertebrate communities will be obtained from TNRCC or other widely accepted sources of literature sources such as the Oak Ridge National Laboratory [ORNL]. The SBVs for terrestrial birds and mammals will be estimated by accounting for soil and food ingestion and by back-calculating to a concentration in soil that is not expected to be harmful to receptors, as shown in the following generic equation:

Soil SBV (mg/kg) = $[TRV \times BW] \div [(SIR \times FI) + (UF \times FIR \times FI)]$ where:

SBV = Screening benchmark value based on soil and food ingestion (mg/kg-day).

TRV = Toxicity reference value (mg/kg-day).

BW = Body weight of receptor (kg).

SIR = Soil ingestion rate by receptor (kg/day).

FI = Fraction ingested from contaminated source (unitless).

UF = Uptake factor of compound by food item (unitless).

FIR = Food ingestion rate (kg/day).

According to EPA guidance, the exposure assumptions that will be used will be based on the lowest body weights and highest ingestion rates found in the literature (EPA, 1997d). The toxicity reference values (TRVs) that will be used in the calculations will be based on the most sensitive experimental species found in the literature for the category of species (e.g., birds, small mammals) being evaluated. These conservative toxicity values when used in conjunction with estimates of average and maximum exposure at the site will result in the estimate of a range of conservative range of screening estimates for the SMS Site.

4.6.1.2 Surface Water/Groundwater

SBVs for surface water will be based on federal ambient water quality criteria (AWQC) (40 CFR 131.36), Texas AWQC (Title 30, Part 1, Chapter 307), or toxicological benchmarks developed by ORNL (Suter and Tsao, 1996) for the general protection of aquatic life. For any benchmark from ORNL that is applied in this assessment, only original values will be used. The 20% adjustment factor generally used by ORNL will not be applied. For certain compounds where insufficient information is available to calculate criteria, the Federal water quality guidance lists lowest-observed-adverse-effect-levels (LOAELs). These values will be extrapolated to NOAELs by dividing by 10, and will be used for screening purposes in those cases where no other SBVs are available.

For screening purposes the groundwater to surface water pathway will be assessed by applying a ten times dilution factor to the surface water benchmark. The ten times dilution factor is based

on discussions with Ron Gouget at the November 2000 SMS Site meeting (EPA, 2000). Analytes in groundwater that exceed 10 times the acceptable surface water benchmark will indicate potential impacts to aquatic life that may be inhabiting Lake Sabine adjacent to the SMS Site.

4.6.1.3 Sediment

SBVs for sediments will be based on sediment screening values from TNRCC (2000) for the protection of benthic organisms. Where no SBVs exist under TNRCC guidance, the lowest Apparent Effects Threshold on a dry weight basis will be used (Barrick et al 1988). If values are not available through either TNRCC or Barrick, the NOAA Screening Quick Reference Table (SQuiRT) numbers will be used (Buchman, 1999).

4.7 RISK SCREENING

The risk screening will integrate the exposure point concentrations (both maximum detected and upper confidence limit of the mean) and the SBVs to estimate the extent of ecological risk from site activities. The risk posed to bird, mammal, and plant receptors as well as aquatic organisms will be assessed by comparing exposure point concentrations to media- and receptor-specific SBVs as discussed above. Specific methodology to be used in presenting the risk screening results is discussed in detail below.

4.7.1 Hazard Quotient Method

The risk screening methodology takes into consideration the potential for risk to be posed by exposure to individual compounds and multiple compounds simultaneously within a given medium (described as cumulative risk). This comparison, will be based on media-specific hazard quotient (HQ) methodology expressed as follows:

$$HQ_{\text{compound}} = C_{\text{medium}} / SBV_{\text{medium}}$$

Where:

$HQ_{\text{compound}} =$ Concentration of a compound in a medium (mg/kg or mg/L).

$C_{\text{medium}} =$ Concentration of a compound in a medium (mg/kg or mg/L).

$SBV_{\text{medium}} =$ Screening benchmark value for the same medium (mg/kg or mg/L).

A calculated compound hazard quotient (HQ) exceeding unity (i.e., >1) indicates that the receptor from which the SBV is based may be at risk to an adverse effect from that compound in that medium. Because SBVs may incorporate a number of extrapolation factors and other conservative assumptions, if an SBV is exceeded (i.e., the hazard quotient exceeds unity), it does not necessarily indicate that an adverse effect will always occur. Additional determinations (e.g., empirical field studies) may be needed as part of a second phase of work for those compounds with screening HQ's that exceeds one.

Exposures to multiple compounds through the same media are assumed to be cumulative. Consequently, a hazard index for multiple compounds within the same media (HI_{medium}) examines the potential for risk posed by a media through more than one compound. For example, the cumulative hazard for multiple compounds in one medium will be determined for each receptor (or receptor group as in the case of surface water and sediment) as follows:

$$HI_{\text{medium}} = HQ_{\text{compound 1}} + HQ_{\text{compound 2}} + \dots + HQ_n$$

Where:

$HI_{\text{medium}} =$ Hazard index for a specific medium (soil, sediment, water).

$HQ_{\text{route 1}} =$ Hazard quotient for the same media from compound 1.

$HQ_{\text{route 2}} =$ Hazard quotient for the same media from compound 2.

Since different compounds often affect different target organs through various mechanisms, HQ's for different compounds may not always be additive. Initially the HQ's for birds and mammals will be added across compounds so that the possibility of HQ's needing to be summed to produce an overall media HI greater than one is not overlooked. If the media HI exceeds one,

ECOLOGICAL RISK ASSESSMENT

the HQ's for those compounds with similar toxic effect mechanisms will be added in order to determine if additivity would result in a media HI that exceeds one for similar toxic effect.

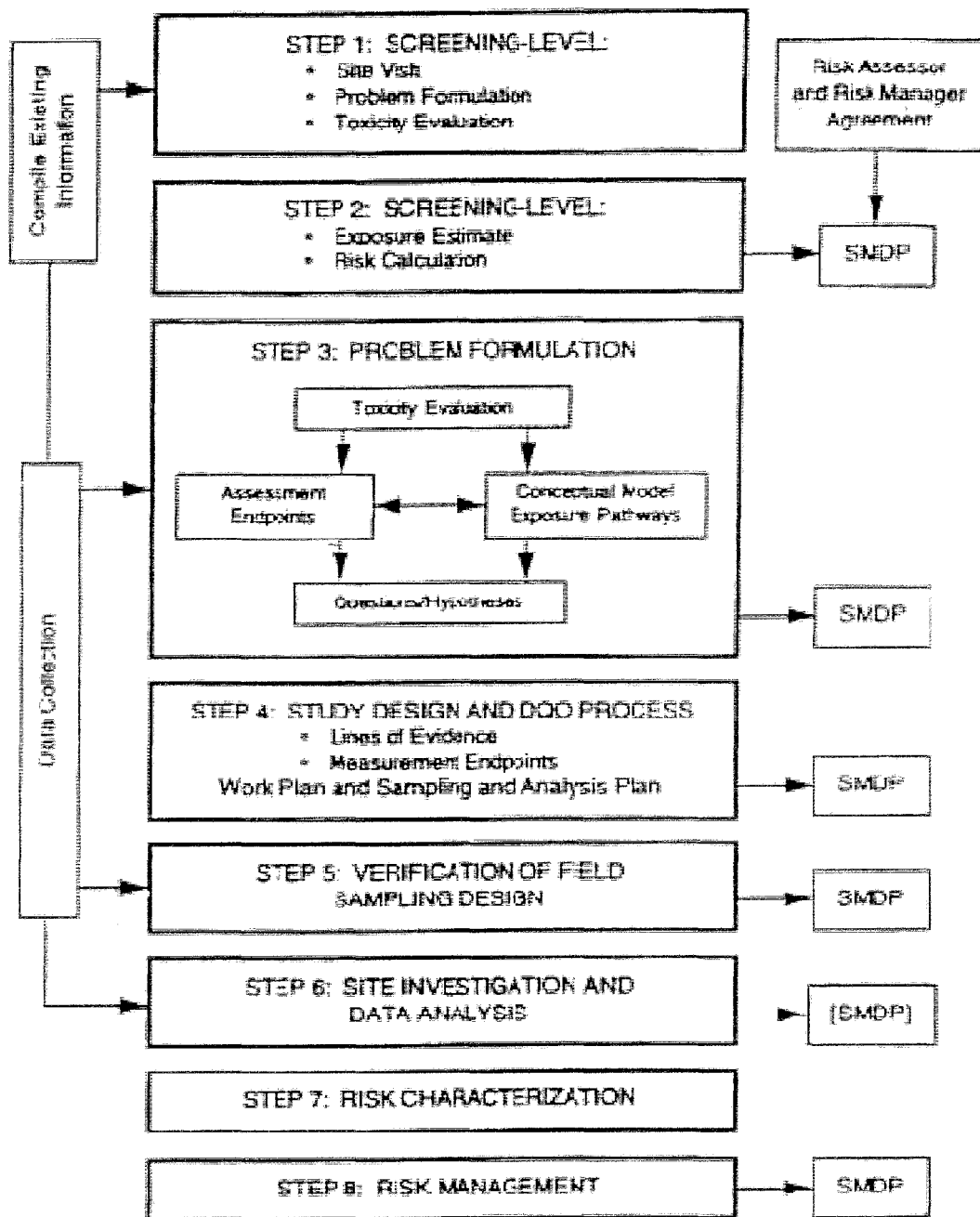


FIGURE 4-1
STATE MARINE SITE
US EPA REGION 6
CERCLA ID NO. TXD099801102
8 STEP ECOLOGICAL RISK
ASSESSMENT PROCESS
FOR SUPERFUND
PORT ARTHUR, JEFFERSON COUNTY, TEXAS

DATE
JAN 01

PROJECT NO.
20074.515.012

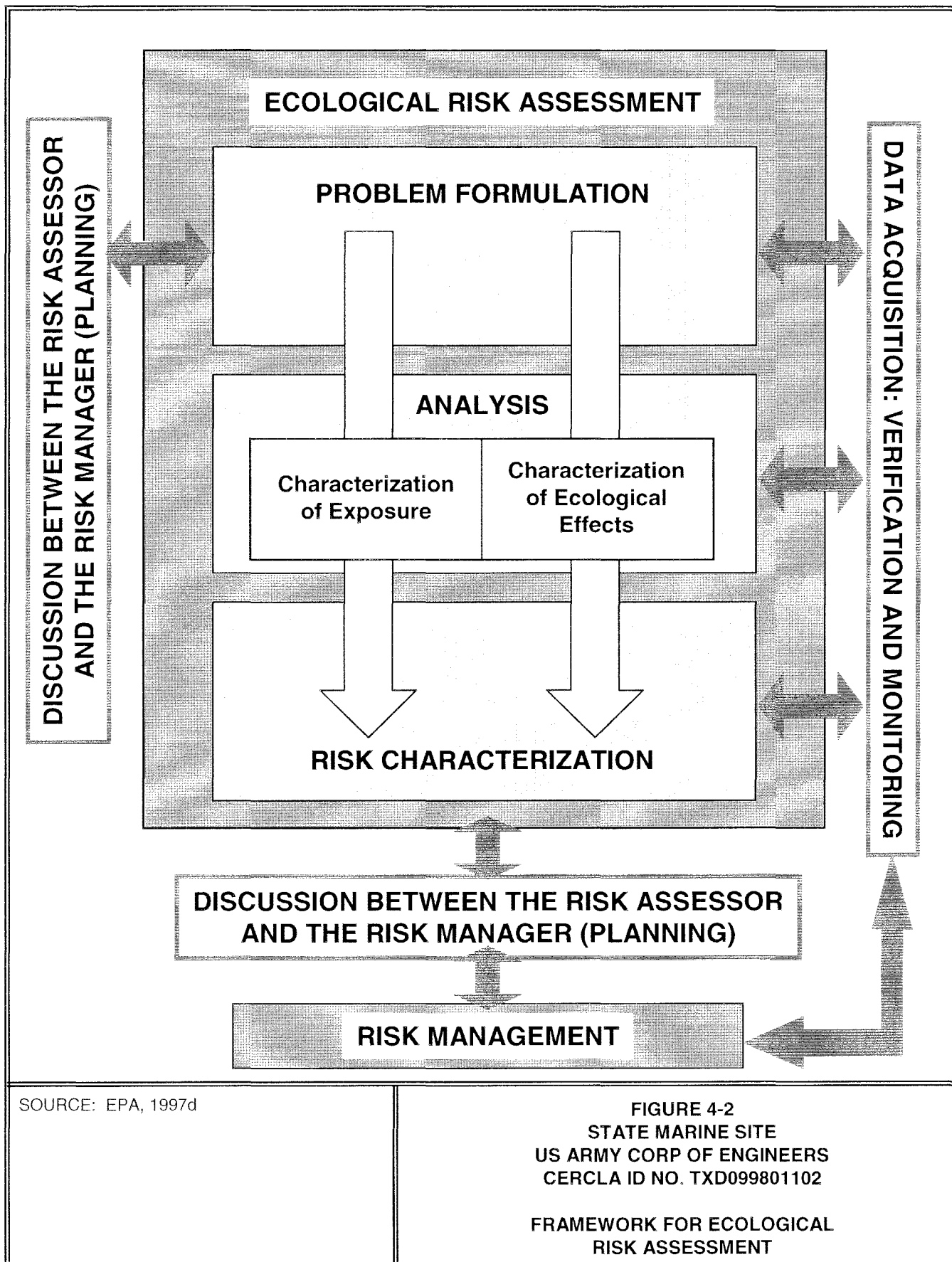


Table 4-1

Federal And State Listings Of Endangered And Threatened Species At Palmer Barge Site

Species Listing	Potential Presence at Palmer Barge
Federal Endangered Species	
Black-capped Vireo (<i>Vireo atricapillus</i>)	Possible
Brown Pelican (<i>Pelecanus occidentalis</i>)	Possible
Eskimo curlew (<i>Numenius borealis</i>)	Possible
Finback Whale (<i>Balaenoptera physalus</i>)	Unlikely
Golden-cheeked Warbler (<i>Dendroica chrysoparia</i>)	Possible
Gulf Coast Jaguarundi (<i>Herpailurus yagouaroundi cacomitli</i>)	Unlikely
Hawksbill Sea Turtle (<i>Eretmochelys imbricata</i>)	Possible
Humpback Whale (<i>Megaptera novaeangliae</i>)	Unlikely
Kemps Ridley Sea Turtle (<i>Lepidochelys kempii</i>)	Possible
Jaguar (<i>Panthera onca</i>)	Unlikely
Leatherback Sea Turtle (<i>Dermochelys coriacea</i>)	Possible
Mexican Long-nose Bat (<i>Leptonycteris nivalis</i>)	Possible
Northern Aplomado Falcon (<i>Falco femoralis septentrionalis</i>)	Possible
Ocelot (<i>Leopardus pardalis</i>)	Unlikely
Red-cockaded Woodpecker (<i>Picoides borealis</i>)	Possible
Southwestern Willow Flycatcher (<i>Empidonax traillii extimus</i>)	Possible
West Indian Manatee (<i>Trichechus manatus</i>)	Unlikely
Whooping Crane (<i>Grus americana</i>)	Unlikely
Wood Stork (<i>Myceria americana</i>)	Unlikely
Federal Threatened Species	
American Alligator (<i>Alligator mississippiensis</i>)	Possible
Arctic Peregrine Falcon (<i>Falco peregrinus tundrius</i>)	Possible
Bald Eagle (<i>Haliaeetus leucocephalus</i>)	Possible
Green Sea Turtle (<i>Chelonia mydas</i>)	Possible
Loggerhead Sea Turtle (<i>Caretta caretta</i>)	Possible
Louisiana Black Bear (<i>Ursus americanus luteolus</i>)	Unlikely
Mexican Spotted Owl (<i>Strix occidentalis lucida</i>)	Unlikely

Table 4-1 (Continued)

Federal And State Listings Of Endangered And Threatened Species At Palmer Barge Site

Species Listing	Potential Presence at Palmer Barge
Piping Plover (<i>Charadrius melodus</i>)	Possible
State Endangered Species	
Paddlefish (<i>Polydon spathula</i>)	Unlikely
Louisiana Pine Snake (<i>Pituophis melanoleucus ruthveni</i>)	Unlikely
Bald Eagle (<i>Haliaeetus leucocephalus</i>)	Possible
Red-cockaded Woodpecker (<i>Picoides borealis</i>)	Possible
Louisiana Black Bear (<i>Ursus americanus luteolus</i>)	Unlikely
State Threatened Species	
Blackside Darter (<i>Percina maculata</i>)	Unlikely
Bluehead Shiner (<i>Notropis hubbsi</i>)	Unlikely
Creek Chubsucker (<i>Erimyzon oblongus</i>)	Unlikely
Blue Sucker (<i>Cycleptus elongatus</i>)	Unlikely
Texas Horned Lizard (<i>Phrynosoma cornutum</i>)	Unlikely
Alligator Snapping Turtle (<i>Macrolemys temminckii</i>)	Possible
Canebrake Rattlesnake (<i>Crotalus horridus atricaudatus</i>)	Unlikely
Northern Scarlet Snake (<i>Cemophora coccinea copei</i>)	Unlikely
White-faced Ibis (<i>Plegadis chihi</i>)	Possible
Wood Stork (<i>Myceria americana</i>)	Possible
Piping Plover (<i>Charadrius melodus</i>)	Possible
American Swallow-tailed Kite (<i>Elanoides forficatus</i>)	Possible
Arctic Peregrine Falcon (<i>Falco peregrinus tundrius</i>)	Possible
Bachman's Sparrow (<i>Aimophila aestivalis</i>)	Possible
Eastern Big-eared Bat (<i>Plecotus rafinesquei</i>)	Possible
River Otter (<i>Lutra canadensis</i>)	Possible

Sources: TPWD, 1995; U.S. Fish & Wildlife Service, 1994, 1995; CLI, 1995.

5. DATA GAPS

5.1 INTRODUCTION

Several risk assessment-related data gaps were identified based on a review of the historical data prior to preparation of this work plan. These data gaps are presented separately for the baseline human health and ecological risk assessments and then discussed by individual medium.

5.1.1 Soil

5.1.1.1 Data Gaps

The TNRCC 1995 ESI focused sampling in shallow soils in the suspected source areas to confirm releases. However, sampling was not extended beyond the source areas to determine the full extent of the soils impacted by the release.

5.1.1.2 Recommended Sampling

Surface (0 to 6 inches) and subsurface soil (6 inches to the water table) samples should be collected from additional borings located in the vicinity of the major sources and extending radially from the source areas. In addition, some samples should be collected within the footprint of the municipal landfill burn pit and along the shoreline immediately adjacent to the bulkhead along the pier. Where possible, these borings can be drilled during the installation of the recommended additional groundwater monitoring wells. Surface and subsurface soil samples from deeper intervals should be taken from these proposed borings to further delineate the extent of soil contamination.

Grassy areas on the western portion of the site that could potentially represent habitat for mammals, birds, or other wildlife should be sampled for ecological purposes. A brief ecological habitat and species survey of the site and any adjacent areas that could be potentially impacted

by the site should be conducted as part of the soils evaluation. Background locations also need to be sampled to address ambient metals concentrations on-site.

Soils should be analyzed for the target compound list (TCL) semi-volatile compounds and for the target analyte list (TAL) metals. Volatile organics, pesticides, and PCBs were detected infrequently and at relatively low levels (CH2M Hill, 1999). Because of low levels of exposure and limitations in contract funding, analyses for these groups of compounds were not considered.

5.1.2 Surface Water/Sediment

5.1.2.1 Data Gaps

Nine surface water samples were obtained by the TNRCC in 1996. Three of the nine samples (SW-1 and SW-3) including one duplicate (SW-2) were obtained adjacent to the site and their locations are shown in Excerpt 1. The remainder of samples were collected around Sabine Lake and in the Neches River; however, their specific locations are unknown. Insufficient sediment samples were collected to define the boundary of the area within Sabine Lake that may be affected by the site. Total organic carbon (TOC) data was not obtained for sediments collected during the ESI. In addition, tributyltin (TBT), a common organotin metal associated with ship building and maintenance, was not evaluated in off-site sediments.

5.1.2.2 Recommended Sampling

Additional surface water and sediment samples should be obtained in the area immediately adjacent to and extending from the bulkhead at the SMS Site. Sediment samples should be collected from the inter-tidal and near-shore areas. Surface water and sediment analyses should include TCL organics including SVOCs and for the TAL metals. A subset of the sediment samples should be analyzed for TBT as well as AVS/SEM to determine the bioavailability of specific metals. All sediment samples should include analyses for TOC and a field screen conducting for grain size to assist in collecting appropriate sediment from background areas. Several conventional parameters of the surface water should also be measured including salinity,

pH, conductivity, turbidity, and temperature. Background locations also need to be sampled to address ambient metals concentrations in the off-site areas.

5.1.3 Groundwater

5.1.3.1 Data Gaps

Monitoring well data was not collected from the SMS Site.

5.1.3.2 Recommended Course of Action

Monitoring wells need to be installed downgradient from the major source areas, including the landfill burn pit area. In addition, a series of point-of-compliance wells need to be installed along the shoreline to assess the migration of groundwater to surface water. Several background wells should also be sampled to provide a better estimate of ambient groundwater. Since no data has been obtained for groundwater, the primary focus of the sampling effort should be analyses of the full suite of TCL organics including VOCs, SVOCs, pesticides, and PCBs, and for the TAL metals as well as TBT. Analyses for TAL metals should be based on both filtered (dissolved) and non-filtered (total) water samples. Additionally, total dissolved solids, yield, and salinity should be measured to assess the potability (quality) of the groundwater. A background location needs to be determined and sampled to address potential ambient concentrations of metals on-site.

All monitoring wells installed should be used to evaluate seasonal and tidal fluctuations of local groundwater and related changes in dissolved contaminant concentrations. Sampling should be conducted at specific intervals, over the course of one year or four consecutive quarters.

5.1.4 Biological Studies

Critical habitat and species presence needs to be further delineated at the SMS Site through additional investigation of natural resource databases and through follow-up with limited surveying at the site. Current plant and animal distribution should be noted for the site, as well as

DATA GAPS

any unique habitat (e.g., ponded water) or vegetative features. This information will be used to prepare a limited site habitat map which can be used to identify the potential for specific species to occur at the site that have not been directly identified.

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APPENDIX B

**SAMPLING AND ANALYSIS PLAN FOR THE ON-SITE INVESTIGATION
AREA**

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1. INTRODUCTION

Roy F. Weston, Inc. (WESTON®) was tasked by U.S. Environmental Protection Agency (EPA) Region 6 to perform a Remedial Investigation/Feasibility Study (RI/FS) of the State Marine Superfund Site (hereafter referred to as SMS site) located in Port Arthur, Jefferson County, Texas. The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Identification Number assigned to the site is TXD099801102. WESTON has prepared this site-specific sampling and analysis plan (SAP) to describe the technical scope of work to be performed at the site as part of the RI/FS. It should be noted that the Sampling and Analysis Plan for the Off-Site Investigation of Sabine Lake has been included in Appendix E of the Task Work Plan (TWP).

1.1 OBJECTIVES OF THE INVESTIGATION

WESTON is providing technical assistance to EPA Region 6 for the performance of the RI/FS. The objectives of the RI/FS are to investigate the nature and extent of contamination at the site and to develop and evaluate the potential remedial alternatives in accordance with CERCLA, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and with the National Oil and Hazardous Substances Pollution Contingency Plan (National Contingency Plan [NCP]).

The overall objectives of the RI/FS will be achieved by evaluating data obtained during the field investigation through the collection of sediment, soil, and groundwater samples at the site and Sabine Lake. Specifically, samples will be collected in areas on-site and in off-site areas of the SMS site to evaluate and determine if areas affected with hazardous constituents exist as a result of historical site operations. This SAP addresses soil and groundwater sampling, which will take place in the areas on-site. Sediment sampling activities are addressed in the Sampling and Analysis Plan for the Off-Site Investigation Area in Appendix E of the TWP.

1.2 SAMPLING AND ANALYSIS PLAN FORMAT

The SAP is organized according to the following format:

- Section 1—Introduction.
- Section 2—Field Investigation Activities.
- Section 3—Schedule of Field Activities.

2. FIELD INVESTIGATION ACTIVITIES

The activities that will be conducted during the SMS RI/FS are discussed in this section. Sampling procedures, locations and quality assurance (QA), and the analytical approach that will be used during the RI/FS are discussed. It should be noted that detailed QA information is presented in the site-specific Quality Assurance Project Plan (QAPP) in the TWP (Appendix C).

2.1 SAMPLING STRATEGY

WESTON has developed a sampling strategy intended to collect the data necessary to evaluate and meet the objectives of the RI/FS. An overview of the field activities and the personnel required to complete these tasks is presented in the following subsections.

2.1.1 Overview of Field Activities

The sampling strategy focuses on the collection of samples from selected on-site locations at the SMS site. In general, soil and groundwater samples will be collected from the following on-site areas:

- Former Wastewater Impoundments
- Wastewater Treatment Facility
- Current Aboveground Storage Tank Area
- Maintenance Shed
- Tar Burn Area
- Former Lauren Refining Company (LRC) Tank Farm
- SMS Site Soils

The on-site samples will be collected to evaluate the characteristics and to define the extent of affected media at the site. Additionally, sampling will be conducted to confirm historical results and sources of contamination.

As previously stated, samples will also be collected from off-site areas including Sabine Lake located adjacent to the site as discussed in the Sampling and Analysis Plan for the Off-Site Investigation Area (Appendix E).

2.1.2 Field Personnel

WESTON will mobilize a field team of up to five people to the SMS site to complete the RI/FS field activities. The team will consist of a field team leader (FTL), a field geoscientist, a sample manager (SM), a scientist and a risk assessor. The FTL will be responsible for the technical quality of the work performed in the field and will serve as WESTON's liaison to EPA Region 6 personnel and the community in the field during the RI/FS. The FTL will determine the location of samples in the field, instruct samplers on sample collection procedures, and log the activities at each sample location in the field logbook and QA sample documentation. The SM will generally work at the command post and be responsible for accurate Contract Laboratory Program (CLP) and non-CLP documentation of the samples collected during the RI/FS. The SM will oversee the packaging and shipping of the samples and will be responsible for communicating sample shipments to EPA. The field geoscientist will supervise the soil boring and monitoring well installation activities. The scientist will collect samples, conduct field screening activities, manage equipment, and complete decontamination activities as directed by the FTL. The risk assessor will be responsible for the collection of off-site sediment samples from Sabine Lake. At the discretion of the FTL, the roles of the various personnel may be interchanged on a daily basis.

2.2 PRELIMINARY FIELD ACTIVITIES

Mobilization and preliminary field activities for the RI/FS are discussed below in this section.

2.2.1 Field Activities Review Meeting

WESTON's Project Team Leader (PTL) will conduct a meeting with the entire field team to familiarize them with the RI/FS Scope of Work, discuss the planned field investigation activities, and review the project Health and Safety Plan (HASP) and other relevant WESTON operating procedures. This meeting will be conducted in WESTON's Houston, Texas, office prior to mobilizing to the field.

2.2.2 Mobilization and Command Post Establishment

The WESTON field team will mobilize the equipment required for the RI/FS field investigation from its Regional Equipment Stores (RES) warehouse in Houston, Texas. The team will load equipment for the field investigation in a vehicle prior to the start of field work, and then drive to the site on the day before sampling activities are scheduled to begin.

The field team will establish a command post in an existing site trailer located in the western portion of the site. Equipment used during the RI/FS will be stored inside the trailer. Prior to demobilization, all remaining field supplies and equipment will be transported back to RES.

2.2.3 Health and Safety Plan Implementation

The RI/FS field activities will be conducted in accordance with the site-specific HASP that has been updated for this specific investigation (Appendix D). In general, the HASP specifies that work will proceed in Level D (coveralls and steel-toed boots) in selected sampling areas based on appropriate air monitoring results. A designated Site Health and Safety Coordinator (SHSC) will be responsible for implementation of the HASP during all field investigation activities. All subcontractors will be required to conduct work according to the guidelines and requirements of the HASP.

2.2.4 Sample Location Reconnaissance

WESTON personnel shall complete an initial survey of on-site and off-site sample locations indicated in the SAP. The team will verify that sample locations have been appropriately selected and choose alternative sample locations if proposed locations are inaccessible or if a better sampling location can be found. The FTL will consult with EPA Region 6 personnel before selecting alternative sample locations.

In accordance with WESTON's general health and safety operating procedures, the field team will also drive the route to the hospital specified in the HASP prior to initiating sampling activities.

2.2.5 Residential Property Access and Community Relations

No sampling locations are located on residential property; therefore, access to nearby residential property is not required.

If EPA Region 6 personnel are not present in the field during the RI/FS field activities, the WESTON field team, under the guidance of the WESTON Site Manager and PTL, will manage community relations in the field as directed by EPA Region 6 personnel.

2.2.6 Documentation of Field Sampling Activities

The WESTON FTL, or another designated field team member, will document the RI/FS field activities in bound field logbooks. At a minimum, the information documented in the field logbook for each sample location will include the following:

- The sample location number and the depths of sample collection.
- A description/sketch of the sample location at the site.
- A measurement from the sample location to a physical structure.
- The sample matrix and sample description.
- The analyses for which the samples were collected.
- The date and time of sample collection.

All locations where samples are collected will be documented using a global positioning system (GPS) to obtain horizontal control. A registered surveyor will obtain horizontal and vertical control of all monitoring well locations.

2.2.7 Equipment Management

Sampling equipment will be staged and managed in the command post during the sampling activities. WESTON will provide sufficient dedicated (nondisposable and disposable) sampling equipment to collect samples in a manner so that the number of times that decontamination is performed on a daily basis is minimized.

2.2.8 Decontamination and Investigation-Derived Wastes (IDW)

The nondisposable sampling equipment (soil samplers, hand trowels, and stainless steel bowls) used during the sample collection process will be thoroughly decontaminated before initial use, between use, and at the end of the field investigation. Equipment decontamination will be completed in the following steps:

- High pressure water spray or brush, if needed, to remove soil/sediment from the equipment.
- Nonphosphate detergent and potable water wash to clean the equipment.
- Final potable water rinse.
- Equipment air dried.

Equipment used during drilling activities will be decontaminated by steam cleaning prior to drilling or sampling at a location and between locations. In addition to steam cleaning between drilling locations, the soil sampling equipment such as split-spoons and Shelby tubes, will be scrubbed in a bucket or tub containing nonphosphate detergent and water between uses at each location. This equipment will then be rinsed with potable water before reuse. All decontamination activities will be conducted at a temporary decontamination pad that will be constructed in an area identified prior to the beginning of field activities.

The fluids and excess soil/sediment generated as a result of equipment decontamination will be placed in 55-gallons drums and staged on-site. Water generated from monitor well installation including development water and purge water will also be collected in 55-gallon drums and staged on-site. The drums will be labeled on the side with the name of the site, the contents, sampling location, and date. The analytical data from collected samples will be reviewed after completion of the field activities and disposal options will be evaluated accordingly.

2.3 SAMPLING LOCATIONS

A discussion of on-site sampling locations is presented in the following subsections.

2.3.1 Areas of Investigation

Based on available information and observations recorded during WESTON's site reconnaissance visits and removal activities (primarily conducted at the Palmer barge line site), as well as historical investigations by TNRCC, several on-site and off-site source areas have been identified for sampling. The areas that have been selected for sampling and investigating are listed below.

- Former Wastewater Impoundments
- Wastewater Treatment Facility
- Current Aboveground Storage Tank Area
- Maintenance Shed
- Tar Burn Area
- Former Lauren Refining Company (LRC) Tank Farm
- SMS Site Soils

As part of the on-site sampling strategy, EPA's Fully Integrated Environmental Location Decision Support (FIELDS) system sampling design software was used to create a sampling plan for the SMS RI/FS. The FIELDS software was used to identify and select a specific number of sample locations based on a predetermined distance between each location, the result of which is a grid pattern. The number of borings and grid pattern for each investigation area is discussed in the following subsections.

2.3.2 On-site Soil Sampling Activities

As part of the RI/FS, WESTON will advance a total of 87 shallow soil borings across the site and in identified source areas (those mentioned above) using GeoprobeTM drilling techniques to determine extent of site-related contamination. The proposed shallow soil sampling locations (those targeted for the source areas mentioned above) are shown in Figure 2-1. All soil borings locations will be continuously sampled until terminal depth,

FIELD INVESTIGATION ACTIVITIES

[estimated to be approximately 10 feet below ground surface (bgs)] and selected core samples will be submitted for laboratory analysis. WESTON's on-site geoscientist will maintain drilling logs and record soil descriptions according to the Unified Soil Classification System (USCS). A discussion of the proposed sampling activities within each source area is presented in the following subsection. It should be noted that some sample locations may not be accessible due to obstructions and therefore the proposed number of locations may be reduced.

2.3.2.1 *Former Wastewater Impoundments*

Between about 1974 and 1982, three to six surface impoundments were used for the storage of wastewater and oil. Oily stained soils were observed outside the berms confirming spills and releases of material. According to available information, the impoundments were not lined. A closure plan was prepared, and the impoundments were reportedly closed (exact date unknown). No records exist regarding the disposition of contaminated soil.

WESTON proposes to complete eight borings in this area to investigate the vertical and horizontal extent of contamination. The grid spacing between each boring will be 75 feet by 75 feet. It is anticipated that groundwater is relatively shallow based on proximity of the site to Sabine Lake and information collected during WESTON's ESI. The depth of borings will be terminated when groundwater is encountered, which is anticipated to be approximately 10 feet bgs.

Two soil samples from each boring will be collected and submitted for target compound list (TCL) semivolatile organic compounds (SVOCs) and target analyte list (TAL) inorganic metals analyses. For planning purposes, one soil sample will be taken from a depth of 0 to 6 inches and the second sample from near the anticipated soil/groundwater interface. If sludge or oily material is encountered, a sample of this material will be collected for analysis. Samples of oily material or sludge will most likely be considered high concentration samples and as such, will be submitted to either EPA's Houston, Texas, laboratory or a non-CLP laboratory.

2.3.2.2 Wastewater Treatment Facility

The wastewater treatment facility operated intermittently from about 1974 to 1987. The facility consisted of between three and seven aboveground storage tanks (ASTs) ranging from 300 to 6,000 gallons in capacity. Activities associated with this area included the storage of used oil and petroleum products for boiler fuel. Stained soils were observed during previous TNRCC investigations.

To investigate this area, WESTON proposes to complete four borings on a grid measuring 75 feet by 75 feet. The depth of the borings will be based on a combination of visual and OVM readings but will be terminated when groundwater is first encountered.

Two soil samples from each boring will be collected and submitted for TCL SVOCs and TAL inorganic analyses. If any sludge or oily material is encountered, a sample of this material may be collected for analysis and will be submitted to EPA's Houston, Texas, laboratory or a non-CLP laboratory.

2.3.2.3 Current Aboveground Storage Tank Area

The current aboveground storage tank area consists of three ASTs with capacities ranging from 2,000 to 4,000 gallons. It is reported that these tanks contained various amount and types of petroleum products; however, the period of operation of these tanks is unknown. During TNRCC site inspections, stained soils were observed in the vicinity of the ASTs.

WESTON proposes to complete five soil borings in the area of the ASTs. The grid pattern for this area will be 40 feet by 40 feet. The depth of the borings will be based on a combination of visual and OVM readings but will be terminated at a depth of about 10 feet bgs.

Two soil samples from each boring will be collected and submitted for TCL SVOCs and TAL inorganic analyses. As described earlier, the exact depth of the samples collected will be determined in the field but will be based on a combination of visual and field screening efforts as well as the depth to groundwater. If encountered, a sample of sludge or oily material may be

collected for analysis and submitted to a non-CLP laboratory or to EPA's Houston, Texas, laboratory.

2.3.2.4 *Maintenance Shed*

The maintenance shed served as the maintenance center for numerous pieces of equipment including abandoned tanker trucks and trailers, cars, salvage equipment, old cranes, engines, and containers of waste oil. TNRCC inspections noted the presence of stained soils and refuse in the area of the maintenance shed.

WESTON proposes to investigate this area by completing four borings in a grid pattern of 75 feet by 75 feet around the maintenance shed. Two soil samples from each boring will be collected and submitted for TCL SVOCs and TAL inorganic analyses. All soil samples collected will be field screened using the OVM. If high concentration soils are encountered, one sample of this material will be submitted to the EPA's Houston, Texas, laboratory or a non-CLP laboratory for analysis.

2.3.2.5 *Tar Burn Area*

The tar burn area consisted of numerous 5-gallon containers of what was believed to be roofing tar material. This area caught fire and the contents of the containers spilled onto the surrounding soils.

To investigate the extent of impacted soil, four soil borings in a grid pattern of 75 feet by 75 feet will be completed in the area to determine extent of contaminated material. The depth of the borings will be based on a combination of visual and OVM readings, but are anticipated to be less than 10 feet bgs.

Two soil samples from each boring will be collected and submitted for TCL SVOCs and TAL inorganic analyses.

2.3.2.6 *Former Lauren Refining Company Tank Farm*

The former Lauren Refining Company (LRC) tank farm operated for a period of about 1980 to 1994. Operations at the tank farm included the storage of wastewater and oil that was pumped from barges and stored in six to eight ASTs. A distillation column was also used in the refining operation that reportedly converted waste oil to bunker oil at various times. An earthen berm surrounded the tanks but was reported to be unlined. TNRCC observations included stained oils, tank bottoms, and pools of oil inside the bermed area. The ASTs are not present at the site and are presumed to have been sold or removed.

To investigate the presence of impacted soil in the area of the former LRC area, WESTON proposes to advance seven soil borings to determine the extent of contamination. The grid pattern in this area will consist of a 75 feet by 75 feet spacing. The depth of the borings will be based on a combination of visual and OVM readings and will be terminated when groundwater is encountered.

Two soil samples from each boring will be collected and submitted for TCL SVOCs and TAL inorganic analyses. The exact depth of the samples collected will be determined in the field but will be based on a combination of visual inspection and results from the field screening effort. If potential high concentration samples are encountered during drilling, one sample will be submitted to either the EPA's Houston, Texas, laboratory for analysis or a non-CLP laboratory.

2.3.2.7 *SMS Site Soils*

As part of the RI/FS, WESTON proposes to advance an additional 55 soil borings, as shown in Figure 2-2, across the site to determine the level and extent of any other potential site-related contamination not investigated in the source areas previously described. The grid pattern will be 100 feet by 100 feet. The depth of the borings will be based on a combination of visual and OVM readings.

Two soil samples from each boring will be collected and submitted for TCL SVOCs and TAL inorganic analyses.

2.3.2.8 *On-site Background Selection*

Two soil borings will be completed for background confirmation. Approximate background soil locations are presented on Figure 2-2. Two soil samples will be collected from each boring for TCL SVOCs and TAL inorganic analyses.

2.3.3 *Subsurface Investigation and Monitoring Well Installation*

This subsection describes the field activities that will be conducted to characterize subsurface soils and the local groundwater conditions at the site. Activities that will be conducted include the completion of “deep” soil borings, the conversion of the “deep” borings into monitoring wells, and development and sampling of monitoring wells. The proposed “deep” soil borings and monitoring well locations are illustrated on Figure 2-3.

It should be noted that dredge spoils underlie a majority of the SMS site and consist of various soil types ranging from silty clay to clayey sand that extends to an approximate depth of 10 to 20 feet bgs. As previously mentioned, landfill materials are anticipated to be present in the central and northern portions of the SMS site. Underlying the dredge spoils is reportedly a stiff to very stiff clay, which occurs to a depth of 40 feet below mean sea level (CH2M Hill, 1999).

2.3.3.1 *Subsurface Investigation*

As part of the subsurface investigation, WESTON proposes to advance a total of four “deep borings” across the SMS site. As previously mentioned, four shallow borings will be further advanced and used as deep borings as part of the subsurface investigation. The objectives of the “deep” borings are to gain an understanding of the “natural” subsurface soil conditions beneath the SMS site. All deep borings will be advanced using hollow-stem auger drilling techniques, continuously logged by a WESTON geoscientist, and terminated at a depth corresponding to the base of a naturally occurring material such as clay, which is anticipated to occur at a depth of approximately 40 feet bgs.

2.3.3.2 *Monitoring Well Installation, Development, and Sampling*

At the completion of each “deep” boring, a determination will be made between the WESTON geoscientist and EPA representative, as to whether to convert the soil boring into a groundwater monitoring well. If no well is to be installed, the boring will be grouted as described below. If a well is to be installed, the WESTON geoscientist and EPA representative will determine screen intervals of the monitoring well based on field observations.

All monitoring wells will be constructed of 4-inch diameter, Schedule 40, flush-threaded PVC casing and up to 10 feet of 0.010-inch slotted well screen. The annular space around the screen will be filled with clean, uniform-sized (20 to 40 mesh or similar) silica sand to a minimum height of 2 feet above the top of the screen. A minimum 2-foot-thick layer of bentonite pellets or bentonite slurry will be placed immediately above the sand pack. If bentonite pellets are used, potable water will be poured over the pellets to initiate hydration. The pellets will be allowed to hydrate for at least 30 minutes before grout is added to the borehole. After the bentonite seal is installed, the remaining annular space will be pressure grouted to the surface.

A 5-foot long, 6-inch-diameter outer protective steel casing with a lockable hinged cap will be installed 2 to 3 feet into the grout seal. The riser pipe will terminate no more than 4 inches below the rim of the protective casing. A 4-foot-by-4-foot concrete pad will be installed around the outer base of the protective casing. If requested by EPA Region 6, four barrier posts will be installed in the concrete pads to surround and protect the wells.

Grouting of all boreholes will be performed using a grout mixture consisting of 6 to 8 pounds of bentonite powder per 94-pound bag of Portland cement, mixed with 6 to 8 gallons of water. The boreholes will be pressure grouted to the surface by pumping the grout mixture through a tremie pipe. The hose will be placed at the bottom of the borehole and raised at a rate so that the bottom of the tremie pipe remains below the top of the grout.

All newly installed monitoring wells will be developed no sooner than 24 hours after completion using either submersible pumps, bailers, or other means deemed appropriate by the FTL. The development water will be collected and disposed as described in Subsection 2.2.8. The

FIELD INVESTIGATION ACTIVITIES

submersible pump or bailer will initially be set at the bottom of the well, then slowly moved toward the top of the screen or borehole to ensure that water is drawn through all portions of the screened interval. Wells will be considered developed after all of the following criteria are met:

- The return water is reasonably clear and free of sand.
- Three to five saturated sand filter pack and well casing volumes have been removed.
- Three consecutive measurements of pH, temperature, and conductivity taken 5 minutes apart are within 0.5 pH units, 2°C, and 10% for conductivity.

If the return water from a well does not meet the above criteria after removing 10 well volumes or pumping or bailing the well for an excessive time period, then a decision about whether the well is developed will be made by the WESTON geoscientist with the concurrence of EPA.

The newly installed monitoring wells will be sampled no sooner than 48 hours following the completion of well development. All monitoring wells will be purged and sampled following *Low-flow (Minimal-Drawdown) Groundwater Sampling Procedures* described in U.S. EPA document (EPA/540/S-95/504, April 1996).

2.3.4 Off-Site Sampling Investigation

The Sampling and Analysis Plan for Off-Site Investigation Area is presented in Appendix E.

2.4 SAMPLING PROCEDURES

All soil samples will be collected in general accordance with the *EPA Compendium of ERT Soil Sampling and Surface Geophysics Procedures*. The specific sampling procedures are described below.

Sampling excursions to sampling locations will initiate at the command post where the team will load the necessary equipment and supplies to collect the samples. Once samples are collected and labeled in the field, the SM will return the samples to the command post for final documentation.

2.4.1 Soil Boring Sampling

Soil boring samples will be collected during the GeoProbe™ and hollow-stem auger drilling activities using appropriate sampling devices including Shelby tubes, split-spoons, or core barrel sampling equipment, depending on the cohesiveness of the material encountered. In general, as the sample cores are collected, the outside will be "shaved", if possible, to remove exterior surfaces and reduce the possibility of cross-contamination between sampling depths. Dedicated plastic scoops will be used to collect the sample. All samples collected will be visually classified and selected samples will be field screened using the OVM for the presence of site-related contamination. Samples collected for laboratory analyses will be selected based on visual observations and field screening results.

As described earlier, upon completion of the soil borings, the boreholes will be tremie grouted to the surface using a cement-bentonite grout mixture.

2.4.2 Groundwater Sampling

Groundwater sampling procedures will follow EPA guidance entitled *Low-flow (Minimal-Drawdown) Groundwater Sampling Procedures* (EPA/540/S-95/504, April 1996).

2.4.3 Quality Assurance Samples

WESTON will collect blind field duplicate samples of soil, sediment and groundwater and prepare equipment rinsate blank and field blank samples as needed during the RI/FS. Quality assurance/quality control (QA/QC) samples will be collected according to the following:

- Blind field duplicate soil and groundwater samples will be collected during sampling activities at locations selected by the WESTON FTL. The data obtained from these samples will be used to assist in the quality assurance of the sampling procedures and laboratory analytical data by allowing an evaluation of reproducibility of results. Efforts will be made to collect duplicate samples in locations where there is visual evidence of contamination or where contamination is suspected. Blind field duplicate samples will be collected at the rate of one duplicate sample for every 10 soil/groundwater/waste samples collected (estimate 17 soil/1 groundwater/ 2 waste samples).

FIELD INVESTIGATION ACTIVITIES

- Equipment rinsate blanks will be prepared by pouring laboratory grade deionized water over nondisposable sampling equipment after it has been decontaminated and collecting the rinse water in sample containers for analyses. These samples will be prepared to demonstrate that the equipment decontamination procedures for the sampling equipment were performed effectively. The equipment rinsate blanks will be prepared each day that nondisposable sampling equipment is used (estimate 10).
- Field blanks will consist of Type II organic-free water poured into appropriate sample containers at sampling locations and handled as an actual field sample. The field blank is intended to identify sources of contamination from the sample jar or sample handling in the field and laboratory. Field blanks will only be collected on days when groundwater sampling occurs (estimate 2).

Quality assurance and quality control will be performed as outlined in the Quality Assurance Project Plan (QAPP) provided as Appendix C of the Task Work Plan. The WESTON field team leader will be responsible for QA/QC of the field investigation activities. The CLP and non-CLP laboratories utilized during the RI/FS will be responsible for QA/QC related to the analytical work. WESTON will also collect several samples to help verify that laboratory QA/QC is consistent with the required standards as discussed in the QAPP.

2.5 ANALYTICAL APPROACH

All soil, groundwater and sediment samples collected during the RI/FS will be submitted to either EPA assigned CLP laboratories or non-CLP laboratories for analyses. The CLP laboratories will provide TCL analyses following EPA Statement of Work (SOW) OLM04.2 and TAL (23 metals plus cyanide) analyses following SOW ILM04.1. Only low to medium concentration samples will be submitted to the CLP laboratories. High concentration samples (waste), if collected, will be submitted to either EPA's Houston laboratory or a non-CLP laboratory for the same analyses.

2.6 SAMPLE HANDLING AND DOCUMENTATION

2.6.1 Sample Identification

Sample identification involves the assignment of sample location numbers and sample depth indicators to all samples collected during the RI/FS. The WESTON FTL will specify the sample

FIELD INVESTIGATION ACTIVITIES

location number and depth of the samples in the field, and sampling personnel will record this information using a permanent marker on a label applied to the side of the jar.

Sample locations will be identified in the field, sequentially, as each location is sampled, independent of the physical location of the sample. For example, the first soil sample location will be designated with the sample location identifier “SS-1,” the second location sampled will be designated “SS-2,” and the last location sampled will be designated “SS-k” where “k” will be substituted with the total number of samples collected during the RI/FS. Additional sample matrices and identifiers anticipated to be collected include groundwater “GW” and surface water “SW.” A specific nomenclature for on-site sample identification will be used and is illustrated in Table 2-2

Blind field duplicate samples will be identified in the same manner as the sample locations and will also follow in sequential order. These samples will be given a unique sample number so as not to be obvious to the laboratory.

2.6.2 Sample Containers and Preservation

WESTON will obtain and use precleaned sample containers for samples collected at the site. The sample containers will be certified clean, and documentation of this will be required with each bottle lot.

2.6.3 Sample Container Decontamination

Following sample collection, the sample containers will be returned to the command post and the SM will check the outside of each container to determine if decontamination is necessary. If it is determined that the container needs to be decontaminated, the container will be washed with deionized water and dried with a towel.

2.6.4 Sample Documentation and Management

The samples will initially be identified at the sample location. Upon sample collection, the sampling personnel will record on the lid or a label affixed to the sample containers the sample location, sample depth, and sample time using a permanent marker. Subsequently, the samples will be transferred in a cooler containing ice to the command post where the sample manager will complete the necessary sample documentation procedures.

The samples collected during the RI/FS will be documented and packaged by the sample manager in the field. The sample manager will be trained and experienced in sample documentation and protocol prior to participation in the activities. The sample manager will document each sample after it is collected in general accordance with appropriate sampling guidance using the sample numbers, tags, forms, and seals.

As part of the sample documentation process, the FTL will quality check the work of the sample manager and instruct other field team members to assist with sample documentation as necessary. Personnel assigned to perform the duties of the sample manager may be interchanged at the discretion of the field team leader.

The names and addresses of the participating CLP and non CLP laboratories will be provided by EPA personnel prior to initiation of the sampling activities and on a weekly basis. The sample manager will receive new CLP laboratory assignments every week.

2.6.5 Sample Shipment

The samples will be preserved and packaged in coolers with ice according to CLP guidelines. In general, the samples will be shipped daily Monday through Friday to the participating laboratories by the Federal Express Priority Overnight Service from the Federal Express location in Port Arthur, Texas.

Every day that samples are shipped to the CLP laboratory, the field team leader or sample manager will call the EPA Sample Management Office (SMO) to confirm the sample shipment.

FIELD INVESTIGATION ACTIVITIES

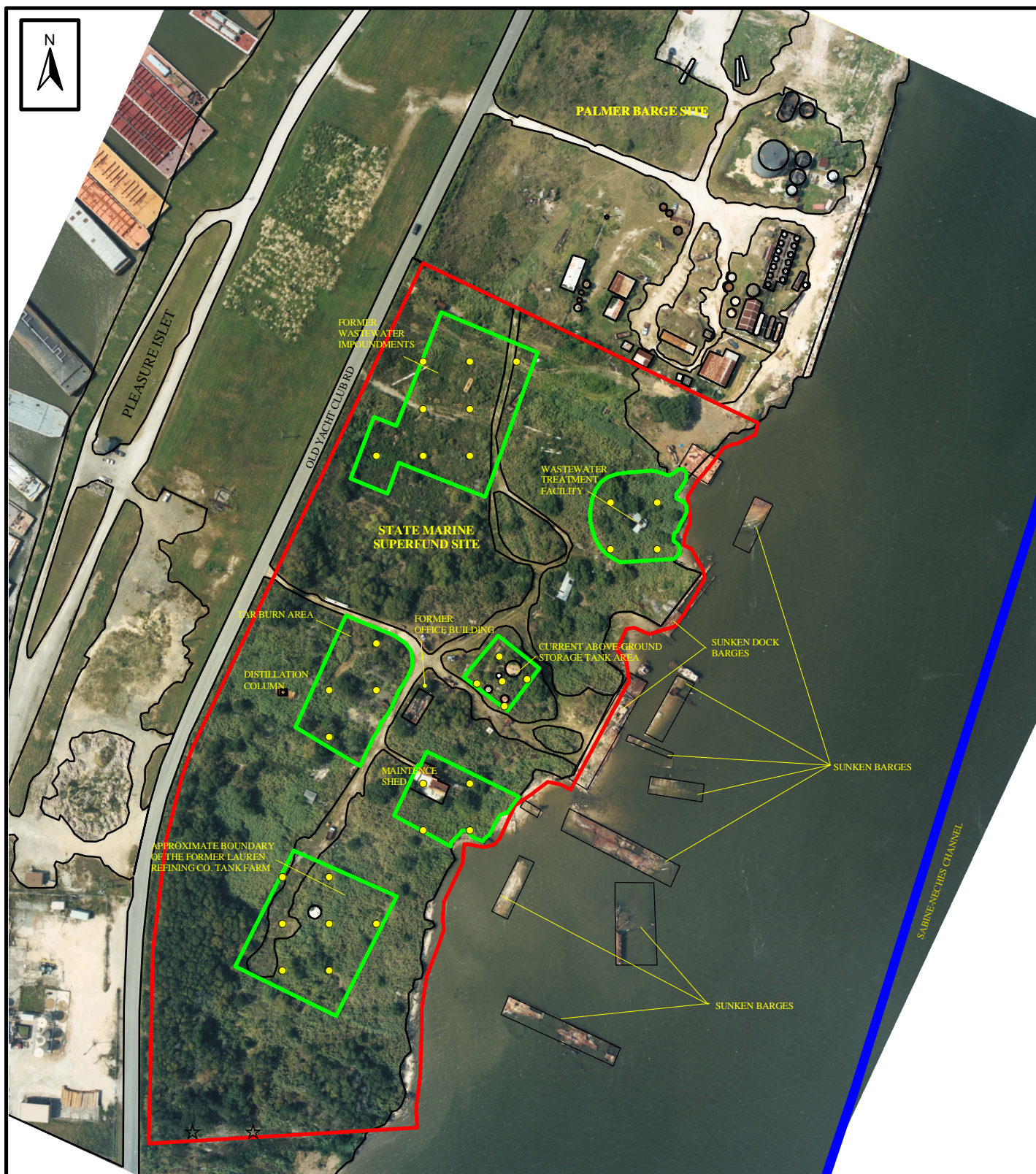
The shipping information, which will be passed on to the SMO, will be the information specified on the back of the sample chain-of-custody/traffic-report forms used for sample documentation and shipping.

In addition, the EPA Regional Sample Contract Coordinator (RSCC) office in Houston, Texas, will be contacted to verify that no issues regarding sample integrity or sample identification have arisen with the CLP laboratories.

2.6.6 Post-Sampling Activities

Post-sampling activities include personnel decontamination and sample handling. Personnel decontamination procedures are presented in Appendix D, the site-specific HASP. When sampling has been completed for a given day, the sampling team will check to make sure that the information needed by the selected analytical laboratory is provided with the samples.

The field team will transport all nondisposable and unused equipment back to the WESTON Regional Equipment Supply (RES) warehouse in Houston, Texas, following the completion of all sampling activities.



LEGEND

- PROPOSED SAMPLING LOCATIONS
- SOURCE AREAS OF INVESTIGATION
- STATE MARINE SUPERFUND SITE PROPERTY BOUNDARY

SOURCE: AERIAL VIEWPOINT
P.O. BOX 692075-294
HOUSTON, TX 77269



FIGURE 2-1
STATE MARINE SUPERFUND SITE
USEPA REGION 6
CERCLA ID NO. TXD099801102
ON-SITE SOURCE AREA SAMPLING LOCATIONS
SAMPLING AND ANALYSIS PLAN
PORT ARTHUR, JEFFERSON COUNTY,
TEXAS

DATE JUL 01	PROJECT NO. 20074.515.012.9989	SCALE AS SHOWN
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LEGEND

- PROPOSED SAMPLING LOCATIONS
- ★ PROPOSED BACKGROUND LOCATIONS



SOURCE AREAS OF INVESTIGATION

— STATE MARINE SUPERFUND SITE PROPERTY BOUNDARY

0 100 200 300 Feet

SOURCE: AERIAL VIEWPOINT
P.O. BOX 692075-294
HOUSTON, TX 77269



FIGURE 2-2

STATE MARINE SUPERFUND SITE
USEPA REGION 6
CERCLA ID NO. TXD099801102
ADDITIONAL ON-SITE SAMPLING LOCATIONS
SAMPLING AND ANALYSIS PLAN
PORT ARTHUR, JEFFERSON COUNTY,
TEXAS

DATE
JUL 01

PROJECT NO.
20074.515.012.9989

SCALE
AS SHOWN



LEGEND



PROPOSED MONITOR WELL LOCATIONS



STATE MARINE SUPERFUND SITE PROPERTY BOUNDARY

0 100 200 300 Feet



FIGURE 2-3

STATE MARINE SUPERFUND SITE
USEPA REGION 6
CERCLA ID NO. TXD099801102
PROPOSED MONITOR WELL LOCATIONS
SAMPLING AND ANALYSIS PLAN
PORT ARTHUR, JEFFERSON COUNTY,
TEXAS

DATE
JUL 01

PROJECT NO.
20074.515.012.9989

SCALE
AS SHOWN

SOURCE: AERIAL VIEWPOINT
P.O. BOX 692075-294
HOUSTON, TX 77269

Table 2-1

On-Site Soil and Groundwater Sample Collection Summary

Sample Location	Sample Collection Method And Number		Sample Matrix and Number			Rationale	Analytical Method
	Method	No. of Locations	Soil	Groundwater	Waste ¹		
Former Wastewater Impoundments	GeoProbe	8	16	0	1	Extent of soil contamination	TCL SVOCs ²
							TAL Inorganics ³
Wastewater Treatment Facility	GeoProbe	4	8	0	1	Extent of soil contamination	TCL Organics
							TAL Inorganics
Current Aboveground Storage Tank Area	GeoProbe	5	10	0	1	Extent of soil contamination	TCL Organics
							TAL Inorganics
Maintenance Shed	GeoProbe	4	8	0	1	Extent of soil contamination	TCL Organics
							TAL Inorganics
Tar Burn Area	GeoProbe	4	8	0	1	Extent of soil contamination	TCL Organics
							TAL Inorganics
Former Lauren Refining Tank Farm	GeoProbe	7	14	0	1	Extent of soil contamination	TCL Organics
							TAL Inorganics
SMS Site Soils	GeoProbe	55	110	0	5	Extent of soil contamination	TCL Organics
							TAL Inorganics
Background Soil (Included in number of SMS site soils)	GeoProbe	2	4	0	0	Background Evaluation	TCL Organics
							TAL Inorganics

Table 2-1 (Continued)

On-Site Soil and Groundwater Sample Collection Summary

Sample Location	Sample Collection Method And Number		Sample Matrix and Number			Rationale	Analytical Method
	Method	No. of Locations	Soil	Groundwater	Waste ¹		
Groundwater Monitoring Wells (Included in number of SMS Site Soils)	HSA	4	0	4	0	Extent of groundwater contamination	SW846 ⁴ Methods
Subtotal No. of On-Site RI/FS Soil Samples		87	174	4	11		
QA/QC						Quality Assurance	EPA SW846 and TCL SVOCs TAL Inorganics
Duplicate Soil Samples (10%)			17	1	2		EPA SW846 and TCL SVOCs TAL Inorganics
Equipment Rinsate Samples			10	0	0		TCL SVOCs TAL Inorganics
Field Blank Samples			0	2	0		EPA SW846
Total No. of On-Site RI/FS Soil Samples			201	7	13		

Notes:

1. Indicates the possibility of waste sample collection.
2. TCL SVOCs– Indicates target compound list for semi-volatile organic compounds using CLP laboratory.
3. TAL Inorganics – Indicates target analyte list for metals and cyanide using the CLP laboratory.
4. EPA Method for VOCs (8260), SVOCs (8270), metals (6010, 7000), TDS.

Table 2-2

Proposed On-Site Sampling and Analysis Summary

Station ^e	Proposed Analyses			
	Soil Quality		Groundwater Quality	
	Surface Chemistry ^a	Subsurface Chemistry ^b	Chemistry ^c	Physical/Conventional ^d
SM046	X	X		
SM047	X	X		
SM048	X	X	X	X
SM049	X	X		
SM050	X	X		
SM051	X	X		
SM052	X	X		
SM053	X	X		
SM054	X	X		
SM055	X	X		
SM056	X	X		
SM057	X	X		
SM058	X	X		
SM059	X	X		
SM060	X	X		
SM061	X	X		
SM062	X	X		
SM063	X	X		
SM064	X	X		
SM065	X	X		
SM066	X	X		
SM067	X	X		
SM068	X	X		
SM069	X	X		
SM070	X	X		
SM071	X	X	X	X
SM072	X	X		

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Table 2-2 (Continued)

Proposed On-Site Sampling and Analysis Summary

Station ^e	Proposed Analyses			
	Soil Quality		Groundwater Quality	
	Surface Chemistry ^a	Subsurface Chemistry ^b	Chemistry ^c	Physical/Conventional ^d
SM073	X	X		
SM074	X	X		
SM075	X	X		
SM076	X	X		
SM077	X	X		
SM078	X	X		
SM079	X	X		
SM080	X	X		
SM081	X	X		
SM082	X	X		
SM083	X	X		
SM084	X	X		
SM085	X	X		
SM086	X	X		
SM087	X	X		
SM088	X	X		
SM089	X	X		
SM090	X	X		
SM091	X	X		
SM092	X	X		
SM093	X	X		
SM094	X	X		
SM095	X	X		
SM096	X	X		
SM097	X	X		
SM098	X	X		
SM099	X	X		

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Table 2-2 (Continued)

Proposed On-Site Sampling and Analysis Summary

Station ^e	Proposed Analyses			
	Soil Quality		Groundwater Quality	
	Surface Chemistry ^a	Subsurface Chemistry ^b	Chemistry ^c	Physical/Conventional ^d
SM100	X	X		
SM101	X	X	X	X
SM102	X	X		
SM103	X	X		
SM104	X	X		
SM105	X	X		
SM106	X	X		
SM107	X	X		
SM108	X	X		
SM109	X	X		
SM110	X	X		
SM111	X	X		
SM112	X	X		
SM113	X	X		
SM114	X	X		
SM115	X	X		
SM116	X	X		
SM117	X	X		
SM118	X	X		
SM119	X	X		
SM120	X	X		
SM121	X	X		
SM122	X	X		
SM123	X	X		
SM124	X	X	X	X
SM125	X	X		
SM126	X	X		

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Table 2-2 (Continued)

Proposed On-Site Sampling and Analysis Summary

Station ^e	Proposed Analyses			
	Soil Quality		Groundwater Quality	
	Surface Chemistry ^a	Subsurface Chemistry ^b	Chemistry ^c	Physical/Conventional ^d
SM127	X	X		
Background				
SM128	X	X		
SM129	X	X		
SM130	X	X		
SM131	X	X		
SM132	X	X		

Notes:

- a: Surface soil chemistry analyses will include SVOCs and TAL metals from 0 to 0.5 feet.
- b: Subsurface soil chemistry analyses will include SVOCs and TAL metals from 0 feet to a terminal depth equal to the groundwater surface elevation.
- c: Groundwater chemistry will include VOCs, SVOCs, TAL metals, and TBT.
- d: Physical and conventional analysis will include temperature, pH, conductivity, salinity, DO, and TDS.
- e: First two characters of station label identify the general area (PB=Palmer Barge, SM=State Marine); the last three characters account for the station number within that area.

TAL = Target Analyte List

SVOC = Semi-Volatile Organic

TBT = Tributyltin

TOC = Total Organic Carbon

TDS = Total Dissolved Solids

DO = Dissolved Oxygen

3. SCHEDULE OF FIELD ACTIVITIES

The tentative schedule for the completion of the SMS RI/FS field investigation is summarized as follows:

- Day 1 and 2: Equipment loading and pre-mobilization activities
- Day 2: Mobilization to Port Arthur, Texas
- Day 3: Preliminary field activities
- Day 4 to Day 10: Sampling activities
- Day 14 - 17: No work
- Day 18 – 27: Sampling activities
- Day 28 – 31: No work
- Day 32 – 42: Sampling activities
- Day 43: Demobilization

APPENDIX C

QUALITY ASSURANCE PROJECT PLAN

**QUALITY ASSURANCE PROJECT PLAN
FOR THE ON-SITE INVESTIGATION AREA**

**STATE MARINE SUPERFUND SITE
PORT ARTHUR, TX**

**APPROVAL OF QUALITY ASSURANCE PROJECT PLAN
FOR SAMPLING AND ANALYTICAL SUPPORT**

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1. GROUP A: PROJECT/TASK ORGANIZATION

1.1 INTRODUCTION

This Quality Assurance Project Plan (QAPP) was prepared by Roy F. Weston, Inc. (WESTON®) as part of a Remedial Investigation/Feasibility Study (RI/FS) associated with the State Marine Superfund Site (hereafter referred to as SMS Site) located in Port Arthur, Texas. This QAPP describes the procedures to be used for collection of samples, their analyses, and the associated measures taken to document the quality of work to be performed during this project. This QAPP will be used to collect analytical data to support the RI/FS for the on-site investigation area being completed for the SMS Site. This QAPP will present the rationale for the proposed sampling design including the intended use of the data. A discussion of the results of the data quality objectives (DQOs) process, including sampling design and its supporting rationale, are also included.

1.2 PROJECT ORGANIZATION AND RESPONSIBILITIES

The organizations and individuals having key roles in the quality control of this project are summarized in Table 1-1. The lines of communication between these key personnel are illustrated in Figure 1-1. It should be noted that a distribution list documenting individuals that have received copies of this QAPP will be maintained in the project files.

1.3 BACKGROUND INFORMATION

The SMS Site is located on Old Yacht Club Road on Pleasure Islet, a peninsula located approximately ½ mile southwest of the mouth of the Neches River where it enters the Sabine-Neches Canal in Jefferson County, Texas. Overall, the site encompasses approximately 34 acres and is bounded to the north by the Palmer Barge Line site, to the west by Old Yacht Club Road, to the south by undeveloped property, and to the east by Sabine Lake.

The Islet on which the SMS Site is located is a manmade landmass, consisting of dredge spoils generated during the construction and maintenance of the Sabine-Neches Canal. The canal was

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PROJECT/TASK ORGANIZATION

constructed between 1898 and approximately 1920, in the vicinity of Sabine Lake and the Neches River, between the current site location and the mainland. Ground elevations range from sea level along the shorelines to a maximum of 11 feet above sea level in the north-central portions of the site. The highest relief on the Islet is associated with the City of Port Arthur's former municipal landfill, which underlies most of the central and northern portions of the site. On-site elevations range from approximately 2 to 7 feet above sea level. Drainage on the Islet is toward the adjacent waterways with surface drainage on the SMS Site occurring to the east-southeast. Sabine Lake is considered an active commercial and recreational fishery supporting a number of sensitive environments.

Analyses of soil and sediment samples collected by Texas Natural Resource Conservation Commission (TNRCC) from on-site and in Sabine Lake confirm the presence of semivolatile organic compounds (SVOCs), pesticides/polychlorinated biphenyls (PCBs), and metals. The SVOCs detected on-site and in sediment samples include benzo(a)anthracene, benzo(a)pyrene, benzo(b)-fluoranthene, chrysene, and phenanthrene, among others. Metals present include lead, barium, chromium, copper, and arsenic. VOCs and pesticide/PCBs were infrequently detected and at low levels. Maximum concentrations of site-specific contaminants are summarized in Tables 1-2 through 1-4. A complete list of U.S. Environmental Protection Agency (EPA) Contract Required Quantitation Limits (CRQLs) and Contract Required Detection Limits (CRDLs) for organic and inorganic constituents following the Statements of Work (SOW) OLM04.2 (May 1999) and ILM04.1 (February 2000) are provided in Tables 2-1 through 2-5 (Section 2).

1.4 PROJECT/TASK DESCRIPTION

WESTON is providing technical support to EPA Region 6 for the performance of an RI/FS of the SMS Site. The objectives of the RI/FS are to investigate the nature and extent of contamination at the SMS Site and to develop and evaluate the potential remedial alternatives for the site, in accordance with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA); and with the National Oil and Hazardous Substances Pollution Contingency Plan (National Contingency Plan [NCP]).

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The objectives of the RI/FS will be achieved by evaluating data obtained during the field investigation through the collection of sediment, soil, surface water, and groundwater samples in locations on and adjacent to the SMS Site.

1.5 QUALITY ASSURANCE OBJECTIVES

The quality assurance objectives for this project are the collection of samples and field information that are technically sound and properly documented, and the generation of data that are statistically valid and of known precision and accuracy. The following discussions of data quality objectives, accuracy, precision, completeness, representativeness, and comparability include and represent the objectives set for this project.

1.5.1 Data Quality Objectives

To accomplish the objectives of the investigation at the SMS Site the data quality objectives (DQOs) presented in Tables 1-5 and 1-6 have been established. The DQO process was developed using the 7-step process set out in the *Guidance for the Data Quality Objective Process: EPA QA/G-4*.

1.5.2 Accuracy

Accuracy is defined as the degree of agreement (nearness) of a measurement or the mean (\bar{x}) of a set of results with an accepted reference or true value. Accuracy is assessed by means of reference samples and percent recoveries. The guidelines for relative accuracy are shown in Table 1-7. The matrix spike recoveries reflect method accuracy.

1.5.3 Precision

Precision is the measure of mutual agreement of a set of replicate results among themselves without assumption of any prior information as to the true result. Precision is assessed by means of duplicate/replicate sample analysis and is best expressed in terms of the standard deviation derived under prescribed similar conditions. The guidelines for relative precision are shown in

Table 1-7. The relative percent difference (RPD) between the matrix spike and matrix spike duplicates represent the analytical precision.

1.5.4 Completeness

Completeness is a measure of the amount of valid data obtained compared to the amount that was expected to be collected under normal operating conditions. Two completeness objectives will be calculated; one based on the total number of samples collected and the second based on those samples reaching the laboratories intact. The goal of this quality assurance/quality control (QA/QC) program is to generate valid data for at least 95% of the samples collected and 98% of the samples analyzed by the laboratory.

1.5.5 Representativeness

Representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, a process condition, an environmental condition, or parameter variations at a sampling point.

The field QA/QC procedures for sample handling, including chain-of-custody (COC) records, will provide for sample integrity until the time of analysis. To make certain that the analytical results of this assessment are representative of the true field conditions, appropriate laboratory QA/QC procedures are prescribed.

1.5.6 Comparability

Comparability expresses the confidence with which one data set can be compared to another. To achieve comparability in this project, the data generated will be reported using units of micrograms per liter ($\mu\text{g/L}$) or milligrams per liter (mg/L) for liquids and milligrams per kilogram (mg/kg) or micrograms per kilogram ($\mu\text{g/kg}$) for solids.

1.5.7 Measurement Performance Criteria

To determine the analytical precision of the method and analyst, replicate analyses are routinely performed for each parameter on at least one sample out of each batch of samples. The results of the replicate analyses are used to calculate the quality control parameter for precision evaluation, the RPD.

The RPD for replicate analyses is defined as 100 times the absolute value of the difference between replicates, divided by the mean of the replicates. For replicate results x_1 and x_2 , the RPD is calculated as:

$$RPD = \left(\frac{|(x_1 - x_2)|}{(x_1 + x_2)/2} \right) \times 100$$

Analytical precision may also be determined by the calculation of the **standard deviation** where more than two replicate measurements of a given sample are made. The following equations are used to calculate the **mean** (\bar{x}) and the **standard deviation** (s_x).

$$\bar{x} = \frac{\sum_{i=1}^n x_i}{n}$$

and

$$s_x = \sqrt{\frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n - 1}}$$

where:

- x_i : the value of a measurement for sample i ,
- \bar{x} : the mean of the values for n ,
- s_x : the standard deviation of the data set for x , and
- n : the total number of values.

The mean and the standard deviation may also be calculated from the differences between replicates measured on several sets of samples.

PROJECT/TASK ORGANIZATION

Matrix spike/matrix spike duplicate (MS/MSD) analyses are performed to determine the precision and accuracy of analytical methods. MS/MSDs are analyzed according to whichever is more frequent:

- Each group of samples of a similar matrix and concentration level.
- Each 20 samples in a group of samples.

The results of sample spiking are used to calculate the quality control parameter for accuracy evaluation or the **Percent Recovery** (%R).

The %R is defined as 100 times the observed concentration minus the sample concentration, divided by the true concentration of the spike:

$$\%R = \frac{O_i - O_s}{T_i} \times 100$$

where:

- %R: the percent recovery,
- O_i: the observed spiked sample concentration,
- O_s: the sample concentration, and
- T_i: the true concentration of the spike.

The RPDs for each compound are calculated using the following equation:

$$RPD = \left| \frac{D_1 - D_2}{(D_1 + D_2)/2} \right| \times 100$$

where:

D₁=MS result, or first replicate sample result. D₂=MSD result, or second replicate sample result.

The results of these calculations are used in conjunction with other QC criteria to aid the data reviewer in applying more informed professional judgment when necessary.

PROJECT/TASK ORGANIZATION

To assess data representativeness, field-sampling procedures are observed to ensure that samples are collected in a consistent, standardized manner. In addition, the number of samples collected is monitored to ensure that an appropriate amount is collected to be representative of site conditions.

To assess comparability of the data, the final data are reviewed to ensure that they are reported in consistent units and format, and that sample collection, preparation, and analytical techniques are consistent. The extent to which existing and planned analytical data will be compared depends on the similarity of samples and analytical methods in addition to QA objectives.

The total number of data that meet accuracy and precision requirements are divided by the total number of data expected or needed to assess the completeness.

1.6 SPECIAL TRAINING REQUIREMENTS/CERTIFICATION

Training of WESTON employees will be provided to ensure that technical, operational, and quality requirements are understood. In addition, a vigorous ongoing professional development program will be maintained to strengthen staff skills, provide career development, and maintain staff retention. The Project Manager (PM) will establish an appropriate training schedule. All WESTON staff will receive training including, but not limited to, the following:

Logbook Training — Logbook training for the maintenance of field, equipment, and personal logbooks is presented to all employees upon initial employment and as refresher training to ensure accurate and appropriate project documentation.

Health and Safety Training — Health and safety training will be provided to ensure compliance with Occupational Safety and Health Administration (OSHA) as established in 29 CFR 1910.120. This training includes, but is not limited to, 40-hour OSHA HAZWOPER training for new employees, 8-hour annual refresher OSHA training, 8-hour supervisor training, cardiopulmonary resuscitation (CPR), first aid training, blood-borne pathogens training, and hazardous materials shipping training.

PROJECT/TASK ORGANIZATION

Data Validation Training — Staff responsible for an unbiased assessment of analytical data validation will be trained in accordance with the *U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, October 1999* and the *U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, February 1994*.

Certifications — Team members will be encouraged to attain and maintain certifications required for conducting work within the Scope of Work (SOW).

All certificates and/or documentation that record completion of training will be maintained in personnel files.

1.7 DOCUMENTS

1.7.1 Project Documentation

Project information generated by WESTON will be documented in a useable format. Project data and information will be tracked and managed from its inception to its final storage area. Documents and records that will be managed include but are not limited to the following:

- Sample Collection Records (logbooks, field notes, data collection sheets, chain-of-custody records, custody seals, sample tags, phone conversation records, airbills, and corrective action reports).
- Field Analysis Records (chain-of-custody records, sample receipt forms/sample tracking forms, preparation and analysis forms and/or logbooks, tabulated data summary forms and raw data for field samples, standards, QC checks and QC samples).
- Project Data Assessment Records (field sampling audit checklists, field analytical audit checklists, fixed laboratory audit checklists, Performance Evaluation (PE) samples results, data validation reports, phone conversation records, and corrective action reports).

It is the responsibility of the QA Manager (QAM) to ensure the appropriate project personnel have the most current version of the QAPP, including all updates. As updates are made the appropriate number of controlled copies will be distributed to the persons listed on the Distribution List for distribution to the appropriate personnel. The QAM is also responsible for making sure project personnel have initial QAPP training and follow-up training as need.

1.7.1.1 *Field Analysis Data Package Deliverables*

If field analysis of samples is required as part of the RI/FS, then field analytical deliverables will include:

- Raw data (properly labeled with sample IDs and any manual calculations).
- Daily Field QA/QC Form (summarizing duplicate results, Laboratory Control Sample results and acceptable limits, and standard traceability form).
- Summary Table of results (listing sample ID, results, units, and detection limits).

1.7.1.2 *Fixed Laboratory Data Package Deliverables*

All data packages will need to include those elements discussed in Subsection 2.10.3.

1.7.1.3 *Data Reporting Formats*

The data reporting formats will be site-specific, and may include daily summary of results, spreadsheets showing the laboratory results, or tables comparing screening results to laboratory results.

1.7.2 Project Records

The project team will establish and maintain a records management system to collect, maintain and retrieve records.

Overall project records will include the following: copies of the QAPP, Standard Operating Procedures (SOPs), and distribution lists for these documents; and general in-house records (such as instrument calibration and preventive maintenance logs and performance evaluation results; audit reports; purchasing records and documentation).

1.7.2.1 *Audit Files*

The QAM will maintain an audit filing system with the contents organized into categories that are event-specific (i.e., logbook) and task-specific (i.e., administrative, health and safety, and field audits). Each file should contain items as they pertain to a specific audit event, including dated checklists that were used to execute the audit; a copy of the audit report; verification and acknowledgment of corrective action, if any; and the QAM's audit closure statement.

1.7.2.2 *Logbook Program*

Logbooks are issued for all field and data collection projects and assignments. All logbooks are currently tracked by the QAM. The logbooks become part of the site file when the project is closed out and are stored with the completed site files.

Logbooks may be assigned to each piece of equipment such as air monitoring instruments, and field screening instruments for recording calibration information and are treated similar to all logbooks. The WESTON equipment manager in Houston, Texas will manage all calibration records.

1.7.2.3 *Quality-Related Documents*

The following documents provide the WESTON project team with directions for implementing and fulfilling QA requirements:

Quality Assurance Management Plan (QMP) — The Weston QMP provides overall policy statements, procedures, and responsibilities to implement quality throughout the corporation.

U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, October 1999 and U. S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, February 1994 — These EPA guidance documents are used to evaluate all laboratory data generated unless other Region 6 approved validation guidelines are available.

PROJECT/TASK ORGANIZATION

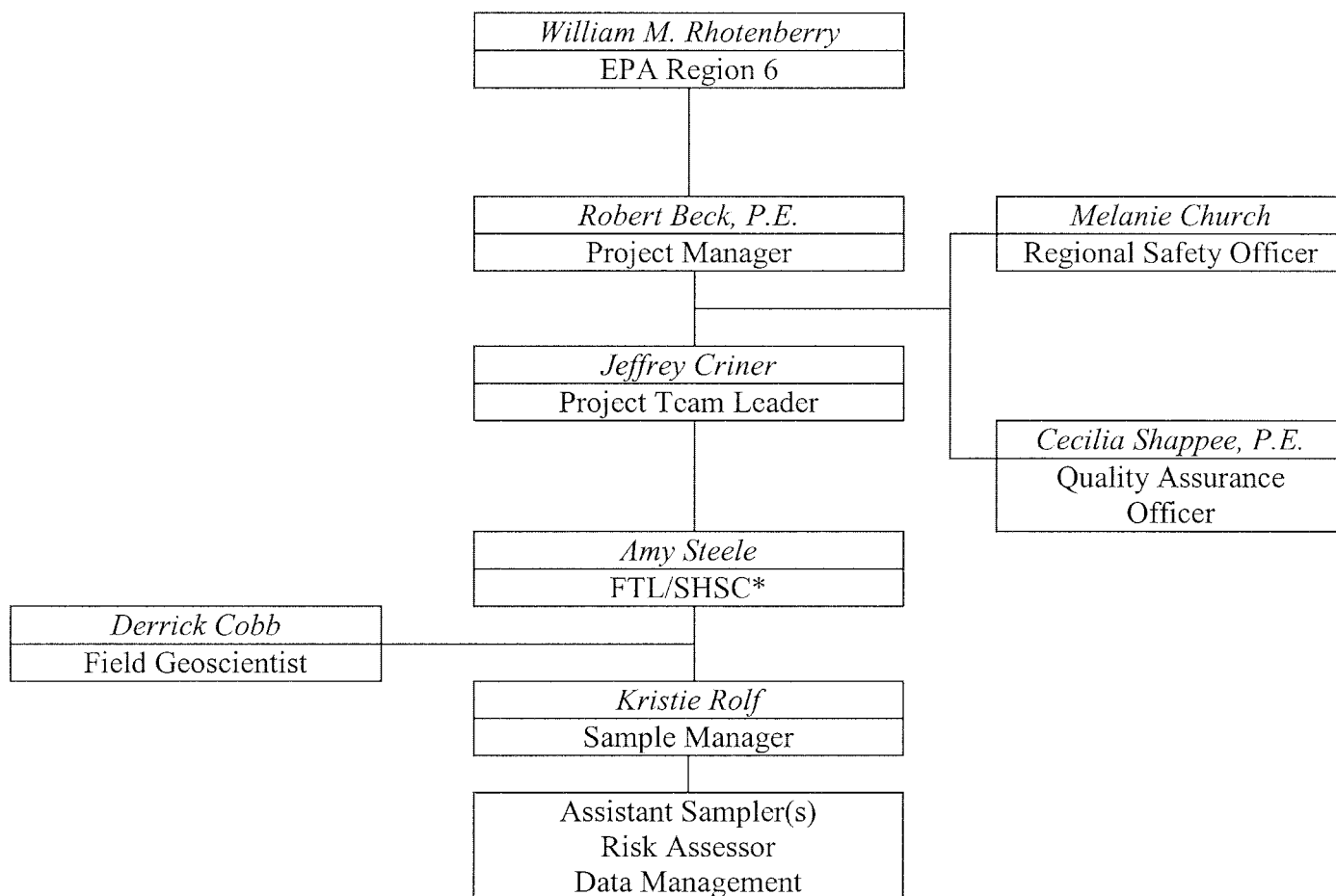
Sampler's Guide to the Contract Laboratory Program (CLP) — This EPA guidance document clarifies sampling procedures necessary to collect and submit samples for CLP analysis.

Compendium of Environmental Response Team (ERT) Standard Operating Procedures — SOPs provide a uniform approach to topics such as sampling, equipment use, and analytical procedures that will be consistently employed by WESTON personnel.

PROJECT/TASK ORGANIZATION

Figure 1-1

Organizational Chart



Notes:

FTL = Field Team Leader

SHSC = Site Health and Safety Coordinator

PROJECT/TASK ORGANIZATION**Table 1-1****Key Personnel and Responsibilities**

ORGANIZATION	NAME (TITLE)	RESPONSIBILITIES
U.S. EPA	William Rhotenberry Work Assignment Manager	Primary contact for the project and responsible for all activities performed for the project, including management of WESTON and other contractors.
WESTON	Robert Beck, P.E. Project Manager	Responsible for all activities performed by WESTON, including coordinating project activities with the WESTON Project Team Leader (PTL), preparing reviewing reports and correspondence submitted to EPA, and attending project meetings.
	Jeffrey J. Criner Project Team Leader	Responsible for directing activities performed by WESTON and assumes total control over project activities. Specific responsibilities include communicating with the EPA, coordinating activities with appropriate support personnel, implementing health and safety criteria, preparing and reviewing reports and correspondence submitted to EPA, and attending project meetings.
	Cecilia Shappee, P.E. QA Officer	Responsible for reviewing project plans, submittals, and documents produced by WESTON. Specifically, she will ensure WESTON submittals, plans, and documents comply with industry and WESTON standards; ensures laboratory QA is conducted and plans are followed; conducts audits; and prepare corrective action memorandums.
Subcontracted Laboratory	TBD Project Manager	Responsible for managing non-CLP sample analyses and coordinating analytical activities with the WESTON PTL. In addition, responsible for the validity and integrity of the analytical results, including submittal of the data deliverables to WESTON.

Table 1-2
Contaminants of Potential Concern (COPCs)
For Soil

Contaminants of Potential Concern ¹	Maximum Detected Concentration (mg/kg)
SVOCs	
2-Methylnaphthalene	0.7J
Acenaphthene	1.5
Acenaphthylene	2.9
Anthracene	3.4
Benzo(a)anthracene	3.3
Benzo(a)pyrene	3J
Benzo(b)fluoranthene	5.9
Benzo(k)fluoranthene	2.4
Carbazole	1.3
Chrysene	8.4
Dibenz(a,h)anthracene	0.49
Dibenzofuran	0.6
Di-n-octylphthalate	0.13J
Fluoranthene	7.9
Fluorene	1.2
Naphthalene	0.86
Pyrene	25
Bis(2-ethylhexyl)phthalate	1.9B
2,4-Dimethylphenol	0.02J
4-Methylphenol	0.042J
4-Nitroaniline	5.4J
Butylbenzylphthalate	0.4
Dimethylphthalate	0.031J
Di-n-butylphthalate	0.3J
N-Nitrosodiphenylamine	0.13J
Volative Organic Compounds (VOCs)	
1,1,1-Trichloroethane	0.009J
1,2-Dichloroethane	0.009J
Acetone	0.055J
Methylene Chloride	0.017
Tetrachloroethene	0.001J
Trichloroethane	0.003J
PESTICIDES/PCBs	
4,4'-DDD	0.105J
4,4'-DDE	0.05
4,4'-DDT	0.057
Aldrin	0.011
alpha-Chlordane	0.029

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Table 1-2 (Continued)
Contaminants of Potential Concern (COPCs)
For Soil

Contaminants of Potential Concern¹	Maximum Detected Concentration (mg/kg)
Aroclor-1248	0.58J
Aroclor-1254	1.1J
Dieldrin	0.054
Endosulfan I	0.015J
Endosulfan II	0.1
Endosulfan sulfate	0.039J
Endrin	0.018J
Endrin aldehyde	0.052
Endrin ketone	0.03T
gamma-BHC (Lindane)	0.0059J
Gamma-Chlordane	0.036
Heptachlor	0.0079J
Heptachlor epoxide	0.041
METALS	
Aluminum	14,100
Antimony	44.7
Arsenic	17.7
Barium	501
Beryllium	27
Cadmium	2.6
Calcium	167,000
Chromium	63.6
Cobalt	65.6
Copper	1,670
Iron	200,000
Lead	4,090
Magnesium	3,920
Manganese	11,320J
Mercury	0.76
Nickel	243
Potassium	3,150
Selenium	4.5
Silver	0.95
Sodium	4,100J

Table 1-2 (Continued)

**Contaminants of Potential Concern (COPCs)
For Soil**

Contaminants of Potential Concern¹	Maximum Detected Concentration (mg/kg)
Thallium	237J
Vanadium	45.3
Zinc	38,700
Cyanide	1.3

(CH2M Hill, 1998)

Notes:

- 1 The contaminants listed in this table reflect maximum concentrations for compounds as reported in CH2M Hill Technical Memorandum for State Marine Superfund Site. 28 October 1998.
- 2 J – Estimated value
- 3 B – Detected in laboratory blank
- 4 mg/kg – Milligrams per kilogram

Table 1-3
Contaminants of Potential Concern (COPCs)
For Sediment

Contaminants of Potential Concern ¹	Maximum Detected Concentration (mg/kg)
SVOCs	
Acenaphthylene	0.58
Anthracene	2
Benzo(a)pyrene	2.3
Benzo(b)fluoranthene	3.6
Benzo(g,h,i)perylene	0.24
Benzo(k)fluoranthene	1.9
Bis(2-ethylhexyl)phthalate	0.26J
Butylbenzylphthalate	0.064J
Carbazole	0.31J
Dibenzofuran	0.36J
Di-n-butylphthalate	0.096
Di-n-octylphthalate	0.22
Fluoranthene	9.1J
Fluorene	0.79
PESTICIDES/PCBs	
Aroclor-1242	0.084J
gamma-BHC (lindane)	0.0034J
METALS	
Aluminum	6,380
Antimony	3.2
Arsenic	11.7
Barium	97
Beryllium	2.7
Cadmium	0.42U
Calcium	30,500
Chromium	20
Cobalt	13.3
Copper	312J
Iron	36,200
Lead	362
Magnesium	3,590
Manganese	745J
Mercury	0.21U
Nickel	26.4
Potassium	2,160
Selenium	1.2U
Silver	0.83U

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Table 1-3 (Continued)
Contaminants of Potential Concern (COPCs)
For Sediment

Contaminants of Potential Concern ¹	Maximum Detected Concentration (mg/kg)
Sodium	3,140J
Thallium	2.1
Vanadium	20.9
Zinc	3,910
Cyanide	1U

(CH2M Hill, 1998)

Notes:

- 1 The contaminants listed in this table reflect maximum concentrations for compounds as reported in CH2M Hill Technical Memorandum for State Marine Superfund Site 28 October 1998.
- 2 J – Estimated value
- 3 B – Detected in laboratory blank
- 4 U – Not detected at instrument detection limit
- 5 mg/kg – Milligrams per kilogram

Table 1-4
Contaminants of Potential Concern
For Surface Water

Contaminants of Potential Concern ¹	Maximum Detected Concentration (mg/L)
SVOCs	
Benzo(g,h,i)perylene	0.0005J
Bis(2-ethylhexyl)phthalate	0.017
VOCs	Not detected
PESTICIDES/PCBs	Not detected
METALS	
Aluminum	1,390
Antimony	3U
Arsenic	3.2
Barium	73.3
Beryllium	1U
Cadmium	1U
Calcium	26,600
Chromium	3.5
Cobalt	2
Copper	17
Iron	3,560
Lead	36.6
Magnesium	60,900
Manganese	113
Mercury	0.2U
Nickel	5.4
Potassium	23,500
Selenium	3
Silver	1.2
Sodium	553,000
Thallium	4U
Vanadium	4.9
Zinc	67.7
Cyanide	10U

(CH2M Hill, 1998)

Notes:

- 1 The contaminants listed in this table reflect maximum concentrations for compounds as reported in CH2M Hill Technical Memorandum for State Marine Superfund Site. October 28, 1998.
- 2 J – Estimated value
- 3 U – Not detected at instrument detection limit
- 4 mg/L – Milligrams per liter

PROJECT/TASK ORGANIZATION

Table 1-5

Data Quality Objectives for Soil/Sediment Sampling

STEP 1. STATE THE PROBLEM	
To determine extent and concentrations of constituents that have been detected in on-site soil and off-site sediment in Sabine Lake.	
STEP 2 IDENTIFY THE DECISION	
Decision to be made: To what extent is on-site soil and off-site sediment affected by the contaminants.	
IDENTIFY THE ALTERNATIVE ACTIONS THAT MAY BE TAKEN BASED ON THE DECISION.	<ul style="list-style-type: none"> The area as defined by a sample location and depth and will be input into the database for the feasibility study process if elevated levels for any constituents of concern are present. The area as defined by a sample location and depth will not be input into the data base for the feasibility study process if no elevated levels for any constituents of concern are present.
STEP 3 IDENTIFY INPUTS TO THE DECISION	
IDENTIFY THE INFORMATIONAL INPUTS NEEDED TO RESOLVE A DECISION.	Contaminant concentrations in soil and sediment samples collected from the site and Sabine Lake.
IDENTIFY THE SOURCES FOR EACH INFORMATIONAL INPUT AND LIST THE INPUTS THAT ARE OBTAINED THROUGH ENVIRONMENTAL MEASUREMENTS.	<ul style="list-style-type: none"> Soil samples from the site. Sediment samples from Sabine Lake. Analytical results for constituents listed in Tables 2-1 and 3-2 (Appendix E).
BASIS FOR THE CONTAMINANT SPECIFIC ACTION LEVELS.	Action levels will be determined as part of the risk assessment developed for the site and Sabine Lake.
IDENTIFY POTENTIAL SAMPLING TECHNIQUES AND APPROPRIATE ANALYTICAL METHODS.	<ul style="list-style-type: none"> Soil borings from the Site and sediment samples from Sabine Lake. OLM04.2 (CLP method for Organic Analysis) or EPA Method 8270. ILM04.1 (CLP method for Inorganic Analysis) or EPA Method 6000/7000 series. AVS/SEM (US EPA Method). TOC (9060 – PSEP modification). Gravimetric Water Content (ASTM D2216).
STEP 4 DEFINE THE BOUNDARIES OF THE DECISIONS	
DEFINE THE DOMAIN OR GEOGRAPHIC AREA WITHIN WHICH ALL DECISIONS MUST APPLY.	The geographic area is the SMS Site and a portion of Sabine Lake adjacent to the site. The locations of the proposed soil borings are shown on Figures 2-1 and 2-2 located in Section 2 of the Off-Site Investigation SAP (Appendix E). The proposed sediment sample locations are shown on Figure 2-1 in Section 2 of the Off-Site Investigation Area SAP (Appendix E).
SPECIFY THE CHARACTERISTICS THAT DEFINE THE POPULATION OF INTEREST.	Contaminant concentrations in soil and sediment samples from the Site and Sabine Lake.
DEFINE THE SCALE OF DECISION-MAKING.	The scale of decision making will be for areas represented by proposed soil borings and sediment sample locations.
DETERMINE THE TIME FRAME TO WHICH THE DATA APPLY.	The data will apply until the soil/sediment represented by the sample receives response actions.
DETERMINE WHEN TO COLLECT DATA.	Samples shall be collected during the RI/FS field sampling activities.
IDENTIFY PRACTICAL CONSTRAINTS ON DATA COLLECTION.	<ul style="list-style-type: none"> Inclement weather. Debris interference (physical).

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PROJECT/TASK ORGANIZATION

Table 1-5 (Continued)

Data Quality Objectives for Soil/Sediment Sampling

STEP 5 DEVELOP A DECISION RULE	
SPECIFY THE PARAMETER THAT CHARACTERIZES THE POPULATION OF INTEREST.	The contaminant concentration within each soil/sediment sample as compared to the specified soil/sediment action level.
SPECIFY THE ACTION LEVEL FOR THE DECISION.	Action levels will be determined as part of the risk assessment developed for the site and Sabine Lake.
DEVELOP A DECISION RULE.	An area as defined by a sample location and depth will be recommended for review in the feasibility study if analytical results exceed the action levels for any constituents of concern in the soil/sediment samples. An area as defined by a sample location and depth will not be recommended for review in the feasibility study if analytical results do not exceed the action levels for any constituents of concern in the soil/sediment samples.
STEP 6 SPECIFY ACCEPTABLE LIMITS ON DECISION ERRORS	
DETERMINE THE POSSIBLE RANGE OF THE PARAMETER OF INTEREST.	Maximum concentrations of historical contaminants in soil and sediment are shown in Tables 1-2 and 1-3.
DEFINE BOTH TYPES OF DECISION ERRORS AND IDENTIFY THE POTENTIAL CONSEQUENCES OF EACH.	<p><u>Type I Error:</u> Deciding that the specified soil/sediment represented by the soil/sediment sample does not exceed specified action levels as determined in the risk assessment, when in truth, the soil/sediment sample concentration of at least one contaminant exceeds the action level. The consequence of this decision error is that contaminated soil/sediment will not receive appropriate response actions, and may endanger human health and the environment. This decision error is more severe.</p> <p><u>Type II Error:</u> Deciding that the specified soil/sediment represented by the soil/sediment sample exceeds the specified action level when in truth, the soil/sediment sample concentrations for all contaminants are below their specified action levels. The consequence of this decision error is that unnecessary response actions will be taken at additional expense.</p>
ESTABLISH THE TRUE STATE OF NATURE FOR EACH DECISION ERROR.	<p>The true state of nature when the soil/sediment is decided to not exceed the specified action levels when, in fact, it does exceed at least one specified action level, is that the soil/sediment may not be remediated.</p> <p>The true state of nature when the soil/sediment is decided to have exceeded the specified action level when in fact, it does not, is that the soil below action levels will be remediated.</p>

Table 1-5 (Continued)

Data Quality Objectives for Soil/Sediment Sampling

STEP 6 SPECIFY ACCEPTABLE LIMITS ON DECISION ERRORS (continued)	
DEFINE THE TRUE STATE OF NATURE FOR THE MORE SEVERE DECISION ERROR AS THE BASELINE CONDITION OR THE NULL HYPOTHESIS (H_0) AND DEFINE THE TRUE STATE FOR THE LESS SEVERE DECISION ERROR AS THE ALTERNATIVE HYPOTHESIS (H_a).	<p>H_0: The concentration of at least one contaminant in a soil/sediment sample is above the specified action level for that contaminant.</p> <p>H_a: There are no contaminant concentrations in a soil/sediment sample above the specified action level.</p>
ASSIGN THE TERMS "FALSE POSITIVE" AND "FALSE NEGATIVE" TO THE PROPER DECISION ERRORS.	<ul style="list-style-type: none"> False Positive Error = Type I False Negative Error = Type II
ASSIGN PROBABILITY VALUES TO POINTS ABOVE AND BELOW THE ACTION LEVEL THAT REFLECT THE ACCEPTABLE PROBABILITY FOR THE OCCURRENCES OF DECISION ERRORS.	The assignment of probability values is not applicable to these DQOs because a non-probabilistic (judgment-based) process has been specified.
STEP 7 OPTIMIZE THE DESIGN	
REVIEW THE DQOS.	Due to insufficient historical data, a meaningful calculation of the standard deviation was not possible. Therefore, the EPA FIELDSD program was used to develop the optimal design. The sampling program recommended satisfies the DQOs and is the most resource effective.
<p>DEVELOP GENERAL SAMPLING AND ANALYSIS DESIGN.</p> <p>Soil and sediment samples will be collected from various soil borings and off-site locations in Sabine Lake and analyzed for the compounds listed in Tables 2-1 through 2-5 (Section 2). Details of the soil and sediment sampling and analysis design are included in Subsection 2.3 of the SAP and Section 2 of this QAPP. Sediment sampling and analysis design is included in the SAP for Off-Site Investigation Area (Appendix E).</p>	

Table 1-6

Data Quality Objectives for Groundwater Sampling

STEP 1. STATE THE PROBLEM	
Determine the nature and extent of contaminants in groundwater.	
STEP 2 IDENTIFY THE DECISION	
Decision to be made: Are there detectable concentrations of any contaminants in the groundwater obtained from monitoring wells?	
IDENTIFY THE ALTERNATIVE ACTIONS THAT MAY BE TAKEN BASED ON THE DECISION.	<ul style="list-style-type: none"> • If contaminants are detected, recommend further assessment or a response action. • If contaminants are not detected, continue with quarterly groundwater monitoring.
STEP 3 IDENTIFY INPUTS TO THE DECISION	
IDENTIFY THE INFORMATIONAL INPUTS NEEDED TO RESOLVE A DECISION.	Contaminant concentrations in groundwater samples collected from Site monitoring wells.
IDENTIFY THE SOURCES FOR EACH INFORMATIONAL INPUT AND LIST THE INPUTS THAT ARE OBTAINED THROUGH ENVIRONMENTAL MEASUREMENTS.	<ul style="list-style-type: none"> • Groundwater samples from Site monitoring wells. • Analytical results for VOCs, SVOCs, metals, total dissolved solids (TDS).
BASIS FOR THE CONTAMINANT SPECIFIC ACTION LEVELS.	Action levels will be determined as part of the risk assessment developed for the Site.
IDENTIFY POTENTIAL SAMPLING TECHNIQUES AND APPROPRIATE ANALYTICAL METHODS.	<ul style="list-style-type: none"> • Grab samples from monitoring wells (see the Sampling and Analysis Plan in Appendix B).
STEP 4 DEFINE THE BOUNDARIES OF THE DECISIONS	
DEFINE THE DOMAIN OR GEOGRAPHIC AREA WITHIN WHICH ALL DECISIONS MUST APPLY.	The study will focus on groundwater in the shallow aquifer below the site. The locations for the proposed monitoring wells are shown on Figure 2-3 located in Subsection 2.3 of the SAP (Appendix B).
SPECIFY THE CHARACTERISTICS THAT DEFINE THE POPULATION OF INTEREST.	Contaminant concentrations in collected groundwater samples.
DEFINE THE SCALE OF DECISIONMAKING.	The scale of decision will be for the shallow aquifer below the site.
DETERMINE THE TIME FRAME TO WHICH THE DATA APPLY.	The data will apply until the next groundwater sampling event.
DETERMINE WHEN TO COLLECT DATA.	Samples shall be collected during the field sampling activities.
IDENTIFY PRACTICAL CONSTRAINTS ON DATA COLLECTION.	<ul style="list-style-type: none"> • Installation and development of monitoring wells. • Volume of water produced by each well. • Inclement weather.
STEP 5 DEVELOP A DECISION RULE	
SPECIFY THE PARAMETER THAT CHARACTERIZES THE POPULATION OF INTEREST.	The groundwater contaminant concentration within each monitoring well as compared to the specified action levels.
SPECIFY THE ACTION LEVEL FOR THE DECISION.	Action levels will be determined as part of the risk assessment developed for the Site.
DEVELOP A DECISION RULE.	If the concentration of contaminants in the groundwater samples are above specified action levels, then the decision-making team will recommend further assessment or a response action.

PROJECT/TASK ORGANIZATION

Table 1-6 (Continued)

Data Quality Objectives for Groundwater Sampling

STEP 6 SPECIFY ACCEPTABLE LIMITS ON DECISION ERRORS	
DETERMINE THE POSSIBLE RANGE OF THE PARAMETER OF INTEREST.	Concentration ranges of historical groundwater contaminants of concern are not known.
DEFINE BOTH TYPES OF DECISION ERRORS AND IDENTIFY THE POTENTIAL CONSEQUENCES OF EACH.	<p><u>Type I Error:</u> Deciding to continue with groundwater monitoring without modification when, in truth, the groundwater concentration of at least one contaminant is detected. The consequence of this decision error is that contaminated groundwater may have migrated off-site and may continue to migrate off-site, possibly endangering human health and the environment. This decision error is more severe.</p> <p><u>Type II Error:</u> Deciding to modify the groundwater monitoring plan and install additional wells when, in truth, the groundwater concentrations of all contaminants are not detected. The consequence of this decision error is that additional costs may be incurred for further study or response.</p>
ESTABLISH THE TRUE STATE OF NATURE FOR EACH DECISION ERROR.	<p>The true state of nature when the groundwater is decided to be below detection limits when in fact, it is not below the detection limit, is that the contaminated groundwater may have migrated off-site and may continue to migrate off-site.</p> <p>The true state of nature when the groundwater is decided to be above the detection limits when in fact, it is not above the detection limits, is that groundwater contamination has not migrated off-site and that additional expense may be incurred for little or no gain.</p>
DEFINE THE TRUE STATE OF NATURE FOR THE MORE SEVERE DECISION ERROR AS THE BASELINE CONDITION OR THE NULL HYPOTHESIS (H_0) AND DEFINE THE TRUE STATE FOR THE LESS SEVERE DECISION ERROR AS THE ALTERNATIVE HYPOTHESIS (H_a).	<p>H_0: Contaminants in the groundwater sample from the specified monitoring well is detected.</p> <p>H_a: Contaminants in the groundwater sample from the specified monitoring well is not detected.</p>
ASSIGN THE TERMS "FALSE POSITIVE" AND "FALSE NEGATIVE" TO THE PROPER DECISION ERRORS.	<ul style="list-style-type: none"> False Positive Error = Type I False Negative Error = Type II
ASSIGN PROBABILITY VALUES TO POINTS ABOVE AND BELOW THE ACTION LEVEL THAT REFLECT THE ACCEPTABLE PROBABILITY FOR THE OCCURRENCES OF DECISION ERRORS.	The assignment of probability values is not applicable to these DQOs because a judgment-based process has been specified.

Table 1-6 (Continued)

Data Quality Objectives for Groundwater Sampling

STEP 7 OPTIMIZE THE DESIGN	
REVIEW THE DQOS.	Due to insufficient historical data, a meaningful calculation of the standard deviation was not possible. Therefore, sample size calculation using the traditional statistical formula may not be the optimal design. In order to select the optimal sampling program that satisfies the DQOs and is the most resource effective, other elements were considered.
<p>DEVELOP GENERAL SAMPLING AND ANALYSIS DESIGN.</p> <p>Since the objective is to confirm the existence of contamination with respect to the established action levels in grab groundwater samples, a non-probabilistic (judgment) sampling approach will be implemented for this phase of the work. The analytical results will guide the decision-making team in deciding whether additional data should be collected.</p> <p>Grab samples will be collected from monitoring wells and analyzed for VOCs, SVOCs, metals and TDS. Details of the groundwater sampling and analysis design are included in the Sampling and Analysis Plan (Appendix B) and Section 2 of this QAPP.</p>	

PROJECT/TASK ORGANIZATION

Table 1-7

Laboratory Data Objectives

Compounds	Precision ¹ (RPD) ² Water/Soil Limits	Accuracy ¹ (MSR) ³ Water/Soil Limits
Volatile Organic Compounds		
1,1-dichloroethene	14/22	61-145/59-172
Trichloroethene	14/24	71-120/62-137
Benzene	11/21	76-127/66-142
Toluene	13/21	76-125/59-139
Chlorobenzene	13/21	75-130/60-133
Semivolatile Organic Compounds		
Phenol	42/35	12-110/26-90
2-chlorophenol	40/50	27-123/25-102
1,4-dichlorobenzene	28/27	36-97/28-104
N-nitroso-di-n-propylamine	38/38	41-116/41-126
1,2,4-trichlorobenzene	28/23	39-98/38-107
4-chloro-3-methylphenol	42/33	23-97/26-103
Acenaphthene	31/19	46-118/31-137
4-nitrophenol	50/50	10-80/11-114
2,4-dinitrotoluene	38/47	24-96/28-89
Pentachlorophenol	50/47	9-103/17-109
Pyrene	31/36	26-127/35-142
Metals and Cyanide		
Aluminum	20	80-120
Antimony	20	75-125
Arsenic	20	80-120
Barium	20	80-120
Beryllium	20	80-120
Cadmium	20	80-120
Calcium	20	80-120
Chromium	20	80-120
Cobalt	20	80-120
Copper	20	80-120
Iron	20	80-120
Lead	20	80-120
Magnesium	20	80-120
Manganese	20	80-120
Mercury	20	80-120
Nickel	20	80-120

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Table 1-7 (Continued)

Laboratory Data Objectives

Compounds	Precision ¹ (RPD) ² Water/Soil Limits	Accuracy ¹ (MSR) ³ Water/Soil Limits
Potassium	20	80-120
Selenium	20	80-120
Silver	20	80-120
Sodium	20	75-125
Thallium	20	80-120
Vanadium	20	80-120
Zinc	20	80-120
Cyanide	20	80-120

¹ The precision and accuracy data are given only for those compounds used in matrix spike/matrix spike duplicate analyses. The overall precision and accuracy of each analytical method will be based on these compounds.

² RPD—Relative Percent Difference.

³ MSR—Matrix Spike Recovery (percent).

2. GROUP B: DATA GENERATION AND ACQUISITION

2.1 SAMPLING PROCESS DESIGN

The sampling event, the media that will be sampled, where the samples will be collected, the number of samples to be collected, and the sampling frequency (if necessary) to be implemented are outlined in the Sampling and Analysis Plan (SAP) for the On-Site Investigation Area (Appendix B). Appendix E contains the Sampling and Analysis Plan for the Off-Site Investigation Area.

2.2 SAMPLING METHODS REQUIREMENTS

Soil, sediment, and groundwater samples that are collected as part of the RI/FS field investigation activities will be analyzed through subcontracted non-CLP laboratories designated by WESTON unless results suggest that project required quantitation limits (PRQLs) allow for analysis under the Superfund Contract Laboratory Program (CLP). Samples that require organic analyses under CLP will follow methods outlined in the EPA CLP SOW for Organic Analyses Multi-Media, Multi-Concentration, Organic Analytical Service for Superfund OLM04.2. Samples requiring CLP inorganic analyses will follow ILM04.1 SOW. The target compounds for analyses of organic and inorganic compounds and the corresponding PRQLs and suggested methods for on-site soil and groundwater are presented in Tables 2-1 and 2-2. Samples collected for analyses that are not covered under the CLP will be analyzed by a non-CLP laboratory or the EPA laboratory (Houston, Texas) following similar CLP techniques.

2.2.1 Sampling Procedures

WESTON will follow procedures set forth in the On-Site Investigation Area SAP, which includes a uniform approach to sampling, equipment use, and analytical procedures that will be consistently employed by WESTON personnel.

GROUP B: DATA GENERATION AND ACQUISITION

2.2.2 Sampling SOP Modifications

Any modifications and the reason for the modification will be documented in writing to the EPA WAM.

2.2.3 Cleaning and Decontamination of Equipment/Sample Containers

Both dedicated and non-dedicated equipment will be used for the project. All non-dedicated equipment involved in field sampling activities will be decontaminated prior to and subsequent to sampling. Decontamination of sampling equipment will be kept to minimum in the field, and wherever possible, dedicated sampling equipment will be used. Decontamination will be accomplished using procedures detailed in the On-Site SAP (Appendix B).

2.3 SAMPLE HANDLING AND CUSTODY REQUIREMENTS

2.3.1 Sampling Collection Documentation

The sampling team and/or individual performing a particular sampling activity will maintain a field logbook. The bound, numbered, and paginated logbook shall be filled out at the location of sample collection immediately after sampling, where practical. The logbook will contain the following sampling information: sample numbers, sample collection times, sample locations, sample descriptions, sampling methods, weather conditions, field measurements, name of sampler(s), site-specific observations, and any deviations from protocols. All logbook entries will be written legibly in permanent ink. If errors are made when completing this logbook, the error will be crossed out with a single line, initialed, and dated by the sampler.

2.3.2 Sampling Handling and Tracking System

Samples will be assigned station numbers as outlined in the On-Site SAP (Appendix B – Table 2-2). In addition, all samples submitted to a fixed laboratory will be assigned either an EPA CLP sample number or a laboratory-specific sample number.

GROUP B: DATA GENERATION AND ACQUISITION

2.3.3 Sample Custody

Sample custody is maintained when a sample is in a secure area or in view of, or under the control of, a particular individual. Personnel responsible for maintaining sample custody will be identified in the SAP.

CHAIN-OF-CUSTODY RECORD - Chain-of-custody records will be prepared to accompany samples from the time of collection and throughout the shipping and analytical process. Each individual in possession of the samples will sign and date the sample chain-of-custody document. The chain-of-custody record will be considered completed upon receipt at the laboratory.

A chain-of-custody record will be maintained from the time the sample is taken to its final deposition. Every transfer of custody must be noted and signed for, and a copy of this record kept by each individual who has signed. When samples (or groups of samples) are not under direct control of the individual responsible for them, they must be stored in a locked container sealed with a custody seal. Specific information regarding custody of the samples projected to be collected on the weekend will be noted in the field logbook.

The chain-of-custody record will include (at minimum) the following:

- Sample identification number.
- Sample information.
- Sample station location.
- Sample date.
- Name(s) and signature(s) of sampler(s).
- Signature(s) of any individual(s) with control over samples.

A separate chain-of-custody form will accompany each cooler for each daily shipment. Within the laboratory, the person responsible for sample receipt will sign and date the chain-of-custody form; verify that custody seals are intact on shipping containers; compare samples received against those listed on the chain-of-custody form; examine all samples for possible shipping damage and improper sample preservation; note on the chain-of-custody record that specific samples were damaged; notify sampling personnel as soon as possible so that appropriate samples may be regenerated; verify that sample holding times have not been exceeded; maintain

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laboratory chain-of-custody documentation; and place the samples in the appropriate laboratory storage.

2.4 ANALYTICAL METHODS REQUIREMENTS

2.4.1 Field Analytical Methods and SOPs

Field measurements such as dissolved oxygen, pH, temperature, conductivity, and oxidation/reduction potentials will be collected during groundwater sampling.

2.4.2 Field Analytical Instrument Calibration

The specific analytical instrument SOP for the calibration criteria and calibration are listed below.

2.4.2.1 *Organic Vapor Meter (OVM) Portable Air Analyzer*

Calibration of the instrument detector will be conducted daily and recorded in the field logbook by the field sampling team.

2.4.2.2 *YSI 600XL*

Calibration of the instrument will be conducted daily with two pH buffers that bracket the pH range of the samples being analyzed. The specific conductivity meter, which is part of the YSI 600 XL, will also be calibrated daily with a standard in the range of the samples being analyzed.

2.4.3 Field Analytical Instrument/Equipment Maintenance, Testing, and Inspection Requirements

Field analytical instruments will be maintained, tested, and inspected as stated in their respective SOP.

2.4.4 Field Analytical Inspection and Acceptance Requirements for Supplies

Supplies will be obtained from reliable vendors and will be compliant with instrument specifications.

2.5 QUALITY CONTROL REQUIREMENTS

2.5.1 Sampling Quality Control

This section identifies the QA/QC sample types that may be analyzed by CLP and subcontract laboratories.

Trip Blanks - Because VOC samples are susceptible to contamination by diffusion of organic contaminants through the sample container [volatile organic analysis (VOA) bottle septum caps], trip blanks must be analyzed to monitor for possible contamination during shipment. Trip blanks shall be prepared to accompany each sample shipment. For water samples, at least two VOA vials will be filled with organic-free water and shipped with the samples. Trip blanks accompany the samples through collection and shipment to the laboratory and are stored with the samples. One trip blank is prepared for each cooler of samples. VOC samples will be consolidated into one cooler for daily shipment, to reduce the number of trip blanks required for analysis.

Analytical results of the trip blank sample are utilized during sample data validation to determine if any cross-contamination has occurred between samples during shipment and/or storage, or if on-site atmospheric contaminants are seeping into the sample vials.

Equipment Blanks — Equipment rinsate blanks are collected to assess cross-contamination brought about by improper decontamination procedures between sampling stations. Equipment rinsate blanks are required for non-dedicated sampling equipment. Daily equipment/rinsate blanks are collected for each type of sampling equipment. They are collected before initial field use of sampling equipment by pouring the appropriate rinsate solvent (e.g., deionized water or solvent rinses) over decontaminated sampling equipment. The rinsate is collected into appropriate sampling containers, preserved, and analyzed for the same parameters as the

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associated environmental samples (excluding physical parameters). Equipment rinsate blanks for VOC analysis must be collected before extractable or inorganic parameters of interest. Equipment rinsate blanks will be shipped with the samples collected the same day. The frequency of equipment rinsate blank collection is one blank per decontamination event per type of equipment, not to exceed more than one per day.

Deionized (DI) Water Blanks - The distilled DI water utilized for the trip and field blanks will be certified as such. A copy of this certificate will be kept on file at the WESTON office.

Field Duplicate Analyses - Environmental duplicates are collected to demonstrate the reproducibility of sampling technique and the variability of the sample matrix. The field duplicate analysis is separate from the laboratory duplicate analysis. At a minimum, one duplicate sample will be collected per each matrix at a frequency of 1 per 20 samples.

MS/MSD Analyses — To evaluate the effect of the sample matrix on the analytical methodology, samples for MS/MSD analysis will be collected at the minimum rate of one per batch of 20 or fewer samples in a case. These samples are spiked in the laboratory with the analyte(s) of interest and analyzed at the same dilution as the original sample. The %R and the RPD for each spiked analyte is then calculated. MS/MSD analyses will be used to evaluate accuracy (via %R) and precision (via RPD).

Split Samples - Splitting of samples will be conducted at the request of EPA when the site owner/operator or potentially responsible party (PRP) wishes to ensure the sample results generated are accurate. It is not necessary to assess the site owner/operator laboratory performance or laboratory methods used, although these methods should be of equivalent performance. The site owner/operator will be informed by EPA that split samples are to be analyzed at their own expense.

Soil and sediment samples collected for VOA may not be split. In this instance, samples must be collected as co-located grabs. Furthermore, it may be necessary to co-locate or depth integrate collection, so that sufficient sample volume is obtained. When splitting aqueous samples, homogenization of the sample is only necessary if heterogeneity is suspected (i.e., leachate).

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Background Samples - In order to assess any potential contamination on the site, background samples for each pathway matrix of concern may be collected. The analysis of background samples will be for the same parameters as those specified for the associated environmental samples. For the purposes of this project, background samples will be collected from locations not suspected to be impacted by on-site activities. Selection of the background sample locations will be based on field observation, available site information, and professional judgment.

In addition to the above QA samples, the laboratory may be required to run additional quality control blanks and checks:

Method Blanks — A method blank is either a volume of distilled, deionized laboratory water for water samples, or a purified solid matrix for soil/sediment samples that is carried through the entire analytical procedure. The volume or weight of the blank must be approximately equal to the sample volume or sample weight processed. A method blank is analyzed with each batch of samples. Analysis of the blank verifies that method interference from contaminants in solvents, reagents, glassware, and other sample-processing hardware are known and minimized. Optimally, a method blank should not contain contamination at a level greater than that specified by the specified analytical method. The results of the analysis of the method blank should be maintained with the corresponding analytical data and summarized in the analytical report.

Check Standard Analyses — Because standards and calibration curves can vary, a midpoint standard or check standard obtained from a source not contained in the initial calibration sequence, is analyzed with each group of samples at the frequency specified in the method, site-specific QAPP, or task work plan. Analysis of this standard is necessary to verify the continued performance of the instrument. This value should be entered into the instrument calibration log whenever the analysis is performed. The source of the check standard, true value, analytical results and other identification will be summarized in the analytical report.

Surrogate Standard Analyses — Surrogate standard determinations are performed on all laboratory samples and blanks for gas chromatography (GC)/mass spectrometry (MS) and GC analyses. All samples and blanks are fortified with surrogate spiking compounds before purging or extraction to monitor the preparation and analysis of samples. Recoveries will be evaluated

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against EPA acceptance criteria, which are established in each laboratory method, work plan, or site-specific QAPP. Surrogate standard recoveries are summarized in the analytical report.

Performance Evaluation Samples — Single-blind Performance Evaluation (PE) samples will be analyzed by the fixed laboratory at a frequency of one per matrix per sampling event. These PEs will be obtained from either the EPA Region 6 QA office or from a commercial vendor. The results of the laboratory analysis will be scored against the established limits. The PE sample is used to evaluate accuracy.

2.6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS

2.6.1 Field Instrument Maintenance

The air monitoring and sampling equipment will be maintained by WESTON. If any equipment is not working properly, it will be removed from service, tagged and removed from stock, and replaced with equipment that is properly functioning. The equipment will not be returned to active service until it is functioning properly. If equipment fails while in the field, it will be immediately reported by the Field Team Leader (FTL), who will coordinate replacing and/or repairing the equipment.

2.6.2 Laboratory Instrument Maintenance

Fixed laboratory instrument maintenance will be addressed in specific analytical Standard Operating Procedures (SOPs) and/or in the laboratory Quality Assurance Project Plan (QAPP).

2.7 INSTRUMENT CALIBRATION AND FREQUENCY

The environmental measurements conducted will be performed in conjunction with health and safety monitoring, emergency responses, site assessments, removal support, and other activities specified in the SOW. Factory calibration will be conducted by a certified service center at intervals identified in the users manual:

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Field Instrument Calibration and Preventive Maintenance — The sampling team is responsible for assuring that the master calibration/maintenance log for each instrument accompanying the operator into the field and maintained. Each log will include at a minimum, where applicable:

- Name, model number and manufacturer of device and/or instrument.
- Instrument serial and/or ID number and date purchased or leased.
- Frequency of calibration.
- Date of calibration.
- Results of calibration, including initial setting, adjustments made and final setting.
- Name of person performing the calibration.

Equipment to be used each day shall be calibrated prior to the commencement of daily activities.

Calibration Procedures — Calibration procedures for each instrument are included in manufacturers' operating manuals or in instrument checklists maintained in WESTON's Health and Safety files, which detail the calibration procedures for field use of health and safety equipment.

Equipment Identification — Each individual air-monitoring instrument is labeled with a unit number.

Calibration Frequency — Instruments and equipment must be calibrated at prescribed intervals or as part of the operational use of the equipment. Frequency will be based on the type of equipment, inherent stability, manufacturer's recommendations, EPA requirements, intended use, effect of error upon the measurement process, prior experience, or other criteria as directed by the PTL. The individual performing the calibration will sign the instrument-specific logbook. Calibration records and schedules must be written and maintained in bound logbooks.

Calibration Failure — Equipment that fails calibration or becomes inoperable during use must be removed from service and segregated to prevent inadvertent use, or be tagged to indicate that it is inoperable/out of calibration. Calibration failure will be recorded in the instrument-specific logbook. Such equipment must be repaired and recalibrated before further use. It is the responsibility of WESTON to ensure that the equipment is serviced expeditiously to reduce downtime.

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Calibration Records — Logbooks will be prepared and monitored by WESTON for each piece of equipment subject to calibration and maintenance. Records demonstrating the traceability of reference standards must also be maintained. WESTON's Regional Equipment Store (RES) staff performing the calibration will record all instrument calibration data in the logbook for the designated instrument.

Records for all calibrated equipment must include the unit number and type of equipment; the date calibration was performed; the identity of the staff performing the calibration; the calibration standard used, including concentration, manufacturer, and lot numbers; and the instrument-specific parameters listed in the front of the instrument logbook.

2.8 INSPECTION/ACCEPTANCE REQUIREMENTS FOR SUPPLIES AND CONSUMABLES

Sample bottles and reagents will be purchased from qualified vendors through a competitive bid process. Each box of glass and plastic sample containers and container of reagents purchased by WESTON will include a *Pre-cleaned Certified Certificate of Compliance*, which indicates that the glass and plastic sample containers and container of reagent were tested for, and found to be free from any target analytes. The PTL or his/her designee will maintain a logbook documenting the lot numbers and certificate of compliance forms received with each box/case of sampling containers and reagent. These lot numbers will be listed in the appropriate site field logbook and will be available for evaluation if analytical data indicate a possible contamination from field sampling practices.

2.9 DATA ACQUISITION REQUIREMENTS (NON-DIRECT MEASUREMENTS)

Previously collected data and other information that will be used to make project decisions will be studied to determine the limitations of the acquired data. Secondary sources of acquired data and information include, but are not limited to the following:

- Historical data (e.g., from organization's/facility's corporate records and/or federal/state or local records pertaining to previous monitoring events, site assessments, investigations, etc).

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- Background information/data from organization's/facility's corporate records and/or federal/state/local records pertaining to site-specific industrial processes, process by-products, past and current chemical uses, raw material and finished product testing, waste testing and disposal practices, and potential chemical breakdown products.
- Data generated to verify innovative technologies and methods.
- Data generated from computer databases (such as manufacturers' process/product information, waste management or effluent information).
- Environmental indicator data obtained from federal/state/local records.
- Computer models or algorithms.
- Literature files/searches.
- Publications.
- Photographs.
- Topographical maps.

If known, all QC procedures, checks and samples that were analyzed with the data set will be listed. The method and/or laboratory-specific QC acceptance criteria used for data generation and whether the data was verified and validated will be noted. If data were verified and/or validated, then the criteria and procedures used will be listed.

2.10 DATA MANAGEMENT

2.10.1 Project Documentation and Records

Project information generated will be documented in a format that is usable by project personnel. Project data and information will be tracked and managed from its inception in the field to its final storage area. Documents and records that will be managed include but are not limited to the following:

- Sample Collection Records (logbooks, field notes, data collection sheets, chain-of-custody records, custody seals, sample tags, phone conversation records, airbills and corrective action reports).

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- Field Analysis Records (chain-of-custody records, sample receipt forms/sample tracking forms, preparation and analysis forms, and/or logbooks, tabulated data summary forms and raw data for field samples, standards, QC checks and QC samples).
- Project Data Assessment Records (field sampling audit checklists, field analytical audit checklists, fixed laboratory audit checklists, PE sample results, data validation reports, phone conversation records and corrective action reports).

2.10.2 Field Analysis Data Package Deliverable

The field analytical deliverables will include the following:

- Raw data (properly labeled with sample IDs and any manual calculations).
- Daily Field QA/QC Forms (summarizing duplicate results, Laboratory Control Sample results and acceptable limits, and standard traceability form).
- Summary Table of results (listing sample ID, results, units and detection limits).

2.10.3 Fixed Laboratory Data Package Deliverables

All data packages will include those elements listed as part of the CLP process.

2.10.4 Data Reporting Formats

The data reporting formats will be site-specific and may include daily summary of results, spreadsheets showing the laboratory results, or tables comparing screening results to laboratory results.

2.10.5 Data Reduction

The techniques used for data analysis, including units, equations, data-recording format, and responsibilities, are defined in the analytical method. Several methods for data analysis or processing may be applied including: manual computation of results directly on the raw data sheet or any calculation pages attached to the data sheets; input of raw data into computer software that performs numerical processing; and direct acquisition and processing of raw data by computer.

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2.10.6 Data Handling and Management

All data generated for the project will be reviewed by the WESTON QAM or his/her designee before inclusion in any report, or before any critical site decisions are made. All data generated by a fixed laboratory will be reviewed in accordance with the *U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review*, October 1999 and/or the *U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, February 1994.

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Table 2-1

Target Analytes, Methods of Analysis, and Quantitation Limit Goals for Soil

Analyte	EPA CRQLs or CRDLs	SITE-SPECIFIC PRQLs ^(a)	Basis for PRQL	Suggested PRQL Reference Methods	CRQL or CRDL Exceeds Site-Specific PRQLs
SVOCs (ug/kg)^(b)					
Benzo(a)pyrene	330	62	Human Health	EPA 8270 - Low Level	YES
2,4-dinitrophenol	830	20000	Ecological	EPA 8270 - Low Level	NO
Dibenzo(a,h)anthracene	330	62	Human Health	EPA 8270 - Low Level	YES
Benzo(a)anthracene	330	622	Human Health	EPA 8270 - Low Level	NO
4-chloro-3-methylphenol	330	332827	Human Health	EPA 8270 - Low Level	NO
Hexachloroethane	330	34760	Human Health	EPA 8270 - Low Level	NO
Hexachlorocyclopentadiene	330	4903	Human Health	EPA 8270 - Low Level	NO
Carbazole ^(c)	330	24332	Human Health	EPA 8270 - Low Level	NO
1,1'-biphenyl ^(c)	330	60000	Ecological	EPA 8270 - Low Level	NO
Acetophenone ^(c)	330	495	Human Health	EPA 8270 - Low Level	NO
Benzaldehyde ^(c)	330	6110310	Human Health	EPA 8270 - Low Level	NO
Caprolactam ^(c)	330	30551549	Human Health	EPA 8270 - Low Level	NO
2,2'-oxybis(1-chloropropane) ^(c)	330	50669	Human Health	EPA 8270 - Low Level	NO
Atrazine ^(c)	330	2192	Human Health	EPA 8270 - Low Level	NO
Isophorone	330	512253	Human Health	EPA 8270 - Low Level	NO
Acenaphthene	330	20000	Ecological	EPA 8270 - Low Level	NO
Diethylphthalate	330	100000	Ecological	EPA 8270 - Low Level	NO
Di-n-butylphthalate	330	1000	Ecological	EPA 8270 - Low Level	NO
Phenanthrene	330	1705203	Human Health	EPA 8270 - Low Level	NO
Butylbenzylphthalate	330	240477	Human Health	EPA 8270 - Low Level	NO
N-nitrosodiphenylamine	330	20000	Ecological	EPA 8270 - Low Level	NO
Fluorene	330	30000	Ecological	EPA 8270 - Low Level	NO
Hexachlorobutadiene	330	6239	Human Health	EPA 8270 - Low Level	NO
Pentachlorophenol	830	879	Ecological	EPA 8151 - modified	NO
2,4,6-trichlorophenol	330	10000	Ecological	EPA 8270 - Low Level	NO
2-nitroaniline	830	3666	Human Health	EPA 8270 - Low Level	NO
2-nitrophenol	330	133131	Human Health	EPA 8270 - Low Level	NO
Naphthalene	330	56030	Human Health	EPA 8270 - Low Level	NO
2-methylnaphthalene	330	2521008	Human Health	EPA 8270 - Low Level	NO
2-chloronaphthalene	330	3855748	Human Health	EPA 8270 - Low Level	NO
3,3'-dichlorobenzidine	330	1081	Human Health	EPA 8270 - Low Level	NO
2-Methylphenol	330	1528276	Human Health	EPA 8270 - Low Level	NO
2-chlorophenol	330	63511	Human Health	EPA 8270 - Low Level	NO
2,4,5-trichlorophenol	830	4000	Ecological	EPA 8270 - Low Level	NO
Nitrobenzene	330	19662	Human Health	EPA 8270 - Low Level	NO

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Table 2-1 (Continued)

Target Analytes, Methods of Analysis, and Quantitation Limit Goals for Soil

Analyte	EPA CRQLs or CRDLs	SITE- SPECIFIC PRQLs ^(a)	Basis for PRQL	Suggested PRQL Reference Methods	CRQL or CRDL Exceeds Site- Specific PRQLs
3-nitroaniline	830	19734	Human Health	EPA 8270 - Low Level	NO
4-nitroaniline	830	123643	Human Health	EPA 8270 - Low Level	NO
4-nitrophenol	830	7000	Ecological	EPA 8270 - Low Level	NO
4-Bromophenyl-phenylether	330	NA	NA	EPA 8270 - Low Level	--
2,4-dimethylphenol	330	1053020	Human Health	EPA 8270 - Low Level	NO
4-methylphenol	330	297851	Human Health	EPA 8270 - Low Level	NO
4-chloroaniline	330	224545	Human Health	EPA 8270 - Low Level	NO
Phenol	330	30000	Ecological	EPA 8270 - Low Level	NO
Bis(2-chloroethyl)ether	330	211	Human Health	EPA 8270 - Low Level	YES
Bis(2-chloroethoxy)methane	330	21	Human Health	EPA 8270 - Low Level	YES
bis(2-ethylhexyl)phthalate	330	910	Ecological	EPA 8270 - Low Level	NO
Di-n-octylphthalate	330	1222062	Human Health	EPA 8270 - Low Level	NO
Hexachlorobenzene	330	304	Human Health	EPA 8270 - Low Level	YES
Anthracene	330	17744113	Human Health	EPA 8270 - Low Level	NO
2,4-dichlorophenol	330	183309	Human Health	EPA 8270 - Low Level	NO
2,4-dinitrotoluene	330	6909	Human Health	EPA 8270 - Low Level	NO
Pyrene	330	1697615	Human Health	EPA 8270 - Low Level	NO
Dimethylphthalate	330	200000	Ecological	EPA 8270 - Low Level	NO
Dibenzofuran	330	266261	Human Health	EPA 8270 - Low Level	NO
Benzo(g,h,i)perylene	330	1780341	Human Health	EPA 8270 - Low Level	NO
Indeno(1,2,3-cd)pyrene	330	622	Human Health	EPA 8270 - Low Level	NO
Benzo(b)fluoranthene	330	622	Human Health	EPA 8270 - Low Level	NO
Fluoranthene	330	2293610	Human Health	EPA 8270 - Low Level	NO
Benzo(k)fluoranthene	330	6219	Human Health	EPA 8270 - Low Level	NO
Acenaphthylene	330	3781513	Human Health	EPA 8270 - Low Level	NO
Chrysene	330	62188	Human Health	EPA 8270 - Low Level	NO
4,6-dinitro-2-methylphenol	830	133131	Human Health	EPA 8270 - Low Level	NO
2,6-dinitrotoluene	330	6909	Human Health	EPA 8270 - Low Level	NO
N-nitroso-di-n-propylamine	330	70	Human Health	EPA 8270 - Low Level	YES
4-chlorophenyl-phenyl ether	330	NA	NA	EPA 8270 - Low Level	--
Metals (mg/kg) ^(b)					
Aluminum	40	50	Ecological	EPA 6010A	NO
Antimony	12	1	Ecological	EPA 6010A	YES
Arsenic	2	6	Ecological	EPA 7060A	NO
Barium	40	252	Ecological	EPA 7421	NO
Beryllium	1	2	Ecological	EPA 6010A	NO
Cadmium	1	4	Ecological	EPA 6010A	NO

Table 2-1 (Continued)

Target Analytes, Methods of Analysis, and Quantitation Limit Goals for Soil

Analyte	EPA CRQLs or CRDLs	SITE-SPECIFIC PRQLs ^(a)	Basis for PRQL	Suggested PRQL Reference Methods	CRQL or CRDL Exceeds Site-Specific PRQLs
Calcium	1,000	NA	NA	EPA 6010A	--
Chromium	2	0.40	Ecological	EPA 6010A	YES
Cobalt	10	7	Ecological	EPA 6010A	YES
Copper	5	15	Ecological	EPA 6010A	NO
Iron	20	15000	Ecological	EPA 6010A	NO
Lead	0.6	15	Ecological	EPA 6010A	NO
Magnesium	1,000	NA	NA	EPA 6010A	--
Manganese	3	300	Ecological	EPA 6010A	NO
Mercury	0.1	0.04	Ecological	EPA 7471A	YES
Nickel	8	10	Ecological	EPA 6010A	NO
Potassium	1,000	NA	NA	EPA 6010A	--
Selenium	1	0.30	Ecological	EPA 7740	YES
Silver	2	2.0	Ecological	EPA 6010A	NO
Sodium	1,000	NA	NA	EPA 6010A	--
Thallium	2	1.0	Ecological	EPA 7841	YES
Vanadium	10	2.0	Ecological	EPA 6010A	YES
Zinc	4	30	Ecological	EPA 6010A	NO
Cyanide	2	780	Ecological	EPA 9010B	NO

Notes:

^(a) PRQLs were based on the following criteria, whichever was lowest: (1) TNRCC Ecological Benchmarks for Soil. Source: *Guidance for Conducting Ecological Risk Assessments at Remediation Sites in Texas. Draft Final. August 28, 2000.* (2) TNRCC Tier 1 Residential PCL ($^{TOT} \text{Soil}_{\text{Comb}}$) (0.5 acre). Source: *Table 1, Chapter 350, Texas Risk Reduction Program.* (3) EPA Risk-Based Concentrations for Residential Soil. Source: *EPA Region 6 Risk-Based Concentration Table (August 2000).*

^(b) CRQLs and CRDLs are expressed on a wet-weight basis; site-specific PRQLs are expressed on a dry-weight basis.

^(c) PRQL laboratory methods could not be verified and may not be able to achieve desired quantitation limits for PRQLs.

NA = Indicates that a project required quantitation limit (PRQL) was not available for this analyte.

CLP = U.S. EPA Contract Laboratory Program

CRDL = Contract Required Detection Limit

CRQL = Contract Required Quantitation Limit

PCL = Protective Concentration Level

PRQL = Project Required Quantitation Limit is lowest value of either the ecological or human health screening benchmark value.

Reference Method = Analytical method required to achieve the project data quality objectives (DQOs).

Sources for CRQLs and CRDLs:

Organics: The USEPA Contract Laboratory Program Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration, OLM04.2. May 1999.

Inorganics: The USEPA Contract Laboratory Program Statement of Work for Inorganic Analysis and Classical Chemistry Parameters Multi-Media, Multi-Concentration. Draft ILM05.0D. January 2000.

Note: This table represents a revision of information from the Final Draft RI/FS Quality Assurance Project Plan (QAPP).

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Table 2-2

Target Analytes, Methods of Analysis, and Quantitation Limit Goals for Groundwater

Analyte	EPA CRQLs or CRDLs (µg/L)	SITE- SPECIFIC PRQLs (µg/L)	Basis for PRQL	Suggested PRQL Reference Methods	CRQL or CRDL Exceeds Site- Specific PRQLs
Conventionals					
Temperature	NA	NA	--	Multimeter Probe	--
pH	NA	NA	--	Multimeter Probe	--
Conductivity	NA	NA	--	Multimeter Probe	--
Salinity (%)	NA	NA	--	Multimeter Probe	--
Dissolved oxygen (DO)	NA	NA	--	Multimeter Probe	--
Total Dissolved Solids (TDS)	NA	NA	--	EPA 160.1	--
VOCs					
1,1,2-trichloro-1,2,2-trifluoroethane	10	59180	Human Health	EPA 8260B - GC/MS	NO
1,1,1-trichloroethane	10	11	Ecological	EPA 8260B - GC/MS	NO
1,1,2,2-tetrachloroethane	10	0.055	Human Health	EPA 8260B - GC/MS	YES
1,1,2-trichloroethane	10	0.200	Human Health	EPA 8260B - GC/MS	YES
1,1-dichloroethane	10	811	Human Health	EPA 8260B - GC/MS	NO
1,2,4-trichlorobenzene	10	5	Ecological	EPA 8260B - GC/MS	YES
1,2-dibromoethane	10	0.001	Human Health	EPA 8260B - GC/MS	YES
1,2-dichlorobenzene	10	20	Ecological	EPA 8260B - GC/MS	NO
1,3-dichlorobenzene	10	5	Human Health	EPA 8260B - GC/MS	YES
1,4-dichlorobenzene	10	0.467	Human Health	EPA 8260B - GC/MS	YES
1,2-dibromo-3-chloropropane	10	0.048	Human Health	EPA 8260B - GC/MS	YES
1,1-dichloroethene	10	0.046	Human Health	EPA 8260B - GC/MS	YES
1,2-dichloroethane	10	0.123	Human Health	EPA 8260B - GC/MS	YES
1,2-dichloropropane	10	0.165	Human Health	EPA 8260B - GC/MS	YES
2-butanone	10	1904	Human Health	EPA 8260B - GC/MS	NO
2-hexanone	10	1467	Human Health	EPA 8260B - GC/MS	NO
4-methyl-2-pentanone	10	158	Human Health	EPA 8260B - GC/MS	NO
Acetone	10	608	Human Health	EPA 8260B - GC/MS	NO
Benzene	10	0.415	Human Health	EPA 8260B - GC/MS	YES
Bromodichloromethane	10	0.181	Human Health	EPA 8260B - GC/MS	YES
Bromoform	10	9	Human Health	EPA 8260B - GC/MS	YES
Bromomethane	10	9	Human Health	EPA 8260B - GC/MS	YES
Carbon disulfide	10	21	Ecological	EPA 8260B - GC/MS	NO
Carbon Tetrachloride	10	0.171	Human Health	EPA 8260B - GC/MS	YES
Chlorobenzene	10	64	Ecological	EPA 8260B - GC/MS	NO
Chloroethane	10	4	Human Health	EPA 8260B - GC/MS	YES
Chloroform	10	0.165	Human Health	EPA 8260B - GC/MS	YES
Chloromethane	10	1.5	Human Health	EPA 8260B - GC/MS	YES
Cyclohexane	10	NA	--	EPA 8260B - GC/MS	--

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Table 2-2 (Continued)

Target Analytes, Methods of Analysis, and Quantitation Limit Goals for Groundwater

Analyte	EPA CRQLs or CRDLs (µg/L)	SITE- SPECIFIC PRQLs (µg/L)	Basis for PRQL	Suggested PRQL Reference Methods	CRQL or CRDL Exceeds Site- Specific PRQLs
cis-1,3-dichloropropene	10	NA	--	EPA 8260B - GC/MS	--
Dibromochloromethane	10	0.133	Human Health	EPA 8260B - GC/MS	YES
Dichlorodifluoromethane	10	395	Human Health	EPA 8260B - GC/MS	NO
Ethylbenzene	10	50	Ecological	EPA 8260B - GC/MS	NO
Isopropylbenzene	10	658	Human Health	EPA 8260B - GC/MS	NO
Methylcyclohexane	10	5217	Human Health	EPA 8260B - GC/MS	NO
Methyl tert-butyl ether (MTBE)	10	20	Human Health	EPA 8260B - GC/MS	NO
Methyl acetate	10	6083	Human Health	EPA 8260B - GC/MS	NO
Methylene Chloride	10	4	Human Health	EPA 8260B - GC/MS	YES
Styrene	10	91	Ecological	EPA 8260B - GC/MS	NO
Tetrachloroethene	10	1.082	Human Health	EPA 8260B - GC/MS	YES
Toluene	10	95	Ecological	EPA 8260B - GC/MS	NO
cis-1,2-dichloroethene	10	61	Human Health	EPA 8260B - GC/MS	NO
trans-1,2-dichloroethene	10	100	Human Health	EPA 8260B - GC/MS	NO
trans-1,3-dichloropropene	10	NA	--	EPA 8260B - GC/MS	--
Trichlorofluoromethane	10	1288	Human Health	EPA 8260B - GC/MS	NO
Trichloroethene	10	2	Human Health	EPA 8260B - GC/MS	YES
Vinyl chloride	10	0.043	Human Health	EPA 8260B - GC/MS	YES
Xylenes (total)	10	294	Ecological	EPA 8260B - GC/MS	NO
SVOCs					
Benzo(a)pyrene	10	0.009	Human Health	EPA 8270 - Low Level	YES
2,4-dinitrophenol	25	6	Ecological	EPA 8270 - Low Level	YES
Dibenzo(a,h)anthracene	10	0.009	Human Health	EPA 8270 - Low Level	YES
Benzo(a)anthracene	10	0.092	Human Health	EPA 8270 - Low Level	YES
4-chloro-3-methylphenol	10	0.300	Ecological	EPA 8270 - Low Level	YES
Hexachloroethane	10	5	Human Health	EPA 8270 - Low Level	YES
Hexachlorocyclopentadiene	10	0.070	Ecological	EPA 8270 - Low Level	YES
Carbazole	10	3.4	Human Health	EPA 8270 - Low Level	YES
1,1'-biphenyl	10	14	Ecological	EPA 8270 - Low Level	NO
Acetophenone	10	0.042	Human Health	EPA 8270 - Low Level	YES
Benzaldehyde	10	3650	Human Health	EPA 8270 - Low Level	NO
Caprolactam	10	18250	Human Health	EPA 8270 - Low Level	NO
2,2'-oxybis(1-chloropropane)	10	13	Human Health	EPA 8270 - Low Level	NO
Atrazine	10	0.303	Human Health	EPA 8270 - Low Level	YES
Isophorone	10	71	Human Health	EPA 8270 - Low Level	NO
Acenaphthene	10	23	Ecological	EPA 8270 - Low Level	NO
Diethylphthalate	10	88	Ecological	EPA 8270 - Low Level	NO

Table 2-2 (Continued)

Target Analytes, Methods of Analysis, and Quantitation Limit Goals for Groundwater

Analyte	EPA CRQLs or CRDLs (µg/L)	SITE- SPECIFIC PRQLs (µg/L)	Basis for PRQL	Suggested PRQL Reference Methods	CRQL or CRDL Exceeds Site- Specific PRQLs
Di-n-butylphthalate	10	5	Ecological	EPA 8270 - Low Level	YES
Phenanthrene	10	4.6	Ecological	EPA 8270 - Low Level	YES
Butylbenzylphthalate	10	19	Ecological	EPA 8270 - Low Level	NO
N-nitrosodiphenylamine	10	14	Human Health	EPA 8270 - Low Level	NO
Fluorene	10	2.0	Ecological	EPA 8270 - Low Level	YES
Hexachlorobutadiene	10	0.320	Ecological	EPA 8270 - Low Level	YES
Pentachlorophenol	25	0.560	Human Health	EPA 8151 - modified	YES
2,4,6-trichlorophenol	10	3.2	Ecological	EPA 8270 - Low Level	YES
2-nitroaniline	25	2.2	Human Health	EPA 8270 - Low Level	YES
2-nitrophenol	10	49	Human Health	EPA 8270 - Low Level	NO
Naphthalene	10	6	Human Health	EPA 8270 - Low Level	YES
2-methylnaphthalene	10	6	Ecological	EPA 8270 - Low Level	YES
2-chloronaphthalene	10	487	Human Health	EPA 8270 - Low Level	NO
3,3'-dichlorobenzidine	10	0.149	Human Health	EPA 8270 - Low Level	YES
2-Methylphenol	10	112	Ecological	EPA 8270 - Low Level	NO
2-chlorophenol	10	30	Human Health	EPA 8270 - Low Level	NO
2,4,5-trichlorophenol	25	12	Ecological	EPA 8270 - Low Level	YES
Nitrobenzene	10	3	Human Health	EPA 8270 - Low Level	YES
3-nitroaniline	25	7	Human Health	EPA 8270 - Low Level	YES
4-nitroaniline	25	24	Human Health	EPA 8270 - Low Level	YES
4-nitrophenol	25	32	Ecological	EPA 8270 - Low Level	NO
4-Bromophenyl-phenylether	10	1.5	Ecological	EPA 8270 - Low Level	YES
2,4-dimethylphenol	10	21	Ecological	EPA 8270 - Low Level	NO
4-methylphenol	10	54	Ecological	EPA 8270 - Low Level	NO
4-chloroaniline	10	98	Human Health	EPA 8270 - Low Level	NO
Phenol	10	110	Ecological	EPA 8270 - Low Level	NO
Bis(2-chloroethyl)ether	10	0.010	Human Health	EPA 8270 - Low Level	YES
Bis(2-chlorooctoxy)methane	10	0.004	Human Health	EPA 8270 - Low Level	YES
bis(2-ethylhexyl)phthalate	10	4.8	Human Health	EPA 8270 - Low Level	YES
Di-n-octylphthalate	10	22	Ecological	EPA 8270 - Low Level	NO
Hexachlorobenzene	10	0.042	Human Health	EPA 8270 - Low Level	YES
Anthracene	10	0.060	Ecological	EPA 8270 - Low Level	YES
2,4-dichlorophenol	10	37	Ecological	EPA 8270 - Low Level	NO
2,4-dinitrotoluene	10	1.3	Human Health	EPA 8270 - Low Level	YES
Pyrene	10	7	Ecological	EPA 8270 - Low Level	YES
Dimethylphthalate	10	330	Ecological	EPA 8270 - Low Level	NO
Dibenzofuran	10	13	Ecological	EPA 8270 - Low Level	NO

Table 2-2 (Continued)

Target Analytes, Methods of Analysis, and Quantitation Limit Goals for Groundwater

Analyte	EPA CRQLs or CRDLs (µg/L)	SITE- SPECIFIC PRQLs (µg/L)	Basis for PRQL	Suggested PRQL Reference Methods	CRQL or CRDL Exceeds Site- Specific PRQLs
Benzo(g,h,i)perylene	10	733	Human Health	EPA 8270 - Low Level	NO
Indeno(1,2,3-cd)pyrene	10	0.092	Human Health	EPA 8270 - Low Level	YES
Benzo(b)fluoranthene	10	0.092	Human Health	EPA 8270 - Low Level	YES
Fluoranthene	10	3.0	Ecological	EPA 8270 - Low Level	YES
Benzo(k)fluoranthene	10	0.921	Human Health	EPA 8270 - Low Level	YES
Acenaphthylene	10	1467	Human Health	EPA 8270 - Low Level	NO
Chrysene	10	7	Ecological	EPA 8270 - Low Level	YES
4,6-dinitro-2-methylphenol	25	2.3	Ecological	EPA 8270 - Low Level	YES
2,6-dinitrotoluene	10	1.3	Human Health	EPA 8270 - Low Level	YES
N-nitroso-di-n-propylamine	10	0.010	Human Health	EPA 8270 - Low Level	YES
4-chlorophenyl-phenyl ether	10	NA	--	EPA 8270 - Low Level	--
Metals					
Aluminum	200	87	Ecological	EPA 6010A	YES
Antimony	60	6	Human Health	EPA 6010A	YES
Arsenic	10	0.045	Human Health	EPA 7060A	YES
Barium	200	4.0	Ecological	EPA 7421	YES
Beryllium	5	4.0	Human Health	EPA 6010A	YES
Cadmium	5	0.600	Ecological	EPA 6010A	YES
Calcium	5,000	NA	--	EPA 6010A	--
Chromium	10	100	Human Health	EPA 6010A	NO
Cobalt	50	1467	Human Health	EPA 6010A	NO
Copper	25	3.100	Ecological	EPA 6010A	YES
Iron	100	1000	Ecological	EPA 6010A	NO
Lead	3	1.0	Ecological	EPA 6010A	YES
Magnesium	5,000	NA	--	EPA 6010A	--
Manganese	15	120	Ecological	EPA 6010A	NO
Mercury	0.2	0.940	Ecological	EPA 7471A	NO
Nickel	40	8	Ecological	EPA 6010A	YES
Potassium	5,000	NA	--	EPA 6010A	--
Selenium	5	5	Ecological	EPA 7740	NO
Silver	10	0.080	Ecological	EPA 6010A	YES
Sodium	5,000	NA	--	EPA 6010A	--
Thallium	10	12	Ecological	EPA 7841	NO
Vanadium	50	20	Ecological	EPA 6010A	YES
Zinc	20	58	Ecological	EPA 6010A	NO
Cyanide	10	1.0	Ecological	EPA 9010B	YES

Table 2-2 (Continued)

Target Analytes, Methods of Analysis, and Quantitation Limit Goals for Groundwater

Analyte	EPA CRQLs or CRDLs (µg/L)	SITE- SPECIFIC PRQLs (µg/L)	Basis for PRQL	Suggested PRQL Reference Methods	CRQL or CRDL Exceeds Site- Specific PRQLs
Organotins					
Tributyltin ^(b)	NA	0.024	Ecological	Krone (1989)	--

Notes:

^(a) Site-specific PRQLs were based on the following criteria, whichever was lowest: (1) TNRCC Ecological Benchmarks for Marine Water. Source: *Guidance for Conducting Ecological Risk Assessments at Remediation Sites in Texas. Draft Final. August 28, 2000.* (2) Texas Water Quality Standards (minimum value between saltwater acute and saltwater chronic). Figure: 30 TAC §307.6(c)(1). *Aquatic Life Standards.* (3) National Ambient Water Quality Criteria (minimum value between saltwater acute and saltwater chronic). EPA-822-F-98-006. (4) TNRCC Tier 1 Residential PCL (^{GW}GW_{ing}). Source: *Table 3, Chapter 350, Texas Risk Reduction Program.* (5) EPA Risk-Based Concentrations for Residential Tap Water. Source: *EPA Region 6 Risk-Based Concentration Table (August 2000).*

^(b) The suggested method for tributyltin is in the ion form. The PRQL is based on TBT as Sb from Ambient Aquatic Life Water Quality Criteria for Tributyltin, U.S.EPA Office of Research and Development, Environmental Research Laboratories, Duluth, MN. Final, March 1991. Suggested method is by Krone = C.A. Krone, et.al. (1989). *A Method for Analysis of Butyltin Species and Measurement of Butyltins in Sediment and English Sole Livers from Puget Sound, Marine Environmental Research 27, p. 1-181 1989.* In order to achieve required detection/quantitation limits, GC/MS utilizing selected ion monitoring (GC/MS-SIM), rather than full scan acquisition is necessary.

NA = Indicates that a project required quantitation limit (PRQL) was not available for this analyte.

CLP = U.S. EPA Contract Laboratory Program

CRQL = Contract Required Quantitation Limit

PCL = Protective Concentration Level

PRQL = Project Required Quantitation Limit is lowest value of either the ecological or human health screening benchmark value.

Reference Method = Analytical method required to achieve the project data quality objectives (DQOs).

Sources for CRQLs and CRDLs:

Organics: *The USEPA Contract Laboratory Program Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration, OLM04.2. May 1999.*

Inorganics: *The USEPA Contract Laboratory Program Statement of Work for Inorganic Analysis and Classical Chemistry Parameters Multi-Media, Multi-Concentration. Draft ILM05.0D. January 2000.*

Note: This table represents a revision of information from the Final Draft RI/FS Quality Assurance Project Plan (QAPP).

3. GROUP C: ASSESSMENT/OVERSIGHT

3.1 ASSESSMENT AND RESPONSE ACTIONS

3.1.1 Planned Assessments

Audits are of two specific types: (1) project audits and (2) field audits. These audits will be performed on an as-needed basis.

Project Audits — Project audits will be conducted to evaluate the quality, completeness, and timeliness of individual project tasks assignments. All nonconformance issues will be brought to the attention of the PM. These audits are conducted by the QAM or his/her trained representative. The audit reports and corrective actions are sent to the PM.

Field Audits — Field audits will be conducted to ensure WESTON field personnel are adhering to proper sampling, administrative, and health and safety SOPs. Field audit considerations should include sample documentation; sampling plan adherence; equipment operation, maintenance, and calibration; proper handling of standards, calibration gases, and preservatives; sampling techniques; decontamination; data management and review; sample custody; packing and shipment procedures; and health and safety practices. Field audits will be conducted by the QAM or PTL on a random basis and in response to reports or findings of poor performance or noncompliance with the QAPP, SOPs, or sound engineering practices. The associated reports and corrective actions are sent to the WESTON PM and EPA WAM, as appropriate.

3.1.2 Assessment Findings and Corrective Action Responses

Corrective action can result from nonconformance to QAPP requirements as observed by WESTON personnel during the course of work audits. Corrective action may be required due to malfunctioning equipment systems and instruments, or equipment systems and instruments that fail calibration or generate data that exceed stated acceptance limits. Nonconformances to SOPs and site-specific QAPPs will also result in corrective action if they have a negative impact on data quality, usability, or established detection limits. It is the responsibility of the PM to assure

GROUP C: ASSESSMENT/OVERSIGHT

that corrective action be initiated as soon as possible. Nonconformance and corrective actions will be documented in the site file memorandum with correspondence to the QAM and the appropriate WESTON personnel if equipment malfunction is observed.

For analytical problems, each specific work plan will address the corrective measures to be taken. Included will be limits of data acceptability, and identification of the corrective action. As appropriate, nonconformance resulting in corrective action will be documented and the resolution evaluated by the QAM. If corrective action is not satisfactorily implemented, resulting in an ongoing nonconformance, the corporate QA Manager will be notified and action taken.

The EPA will be informed of the nonconformance and any corrective action needed or taken as soon as possible.

Corrective action and nonconformance frequency or history will be reviewed as one indicator in determining the efficiency of the continual improvement program.

Any changes and deviations from the QAPP during field activities will be documented in a memorandum addressed to the EPA Work Assignment Manager.

3.1.3 Additional QAPP Nonconformance

Corrective action procedures will be implemented when deviations from the QAPP that could potentially impact data quality and/or usability are noted by project personnel outside the formal assessment process. Any such incidents will be documented and resolved using the procedures and personnel that were detailed for planned assessments in Subsections 3.1.1 and 3.1.2 of this QAPP.

3.2 REPORTS TO MANAGEMENT

In order to ensure that management is periodically updated on the project status and results of QA assessments, QA Management reports will be prepared updating the QAPP on an annual basis.

4. GROUP D: DATA VALIDATION/USABILITY

4.1 DATA REVIEW, VALIDATION AND VERIFICATION REQUIREMENTS

The data analysis scheme, units and equations used to calculate the various constituent concentrations are provided in the appropriate methods as outlined in the On-site and Off-site SAP (Appendix B and Appendix E).

4.2 VALIDATION AND VERIFICATION METHODS

Any data needed for project implementation or decision-making that are obtained from non-measurement sources such as computer databases, programs, literature files, and historical data bases will be compared to the DQOs for the project to determine the acceptability of the data. For example, analytical data from historical surveys will be evaluated to determine whether they satisfy the validation criteria for the project. If the data has not been validated to Region 6 criteria, the package will be examined to determine whether sufficient data are provided to allow a proper validation to be done. If data are not present, then a decision to require additional site sampling may be necessary.

4.2.1 Data Validation

All data generated by or for the project will be reviewed by a qualified WESTON staff member.

If the data were generated by WESTON (by field analysis), then the data will be peer reviewed by another WESTON staff member chemist who is familiar with the analysis. This will ensure that the SOP was followed accordingly, that the instrument was operating properly, and that the data generated is of adequate quality. WESTON will ensure that all results are calculated correctly, and that there were no transcription errors.

If the data were generated by a fixed laboratory, then the data will be reviewed in accordance with the *U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, February 1994 and/or the *U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review*, October 1999.

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GROUP D: DATA VALIDATION/USABILITY

The following are the principal criteria that will be used to validate the data integrity during collection and reporting of the data:

- Verification by the laboratory QC officer that all raw data generated have been properly stored and documented in hard copy and that storage locations in the laboratory are coincident with COC records.
- Examination of the raw data by the Analysis Coordinator to verify adequacy of documentation and check the accuracy of calculations.
- Confirmation that calibration standards are within the expected values.
- Reporting of all associated blank, duplicate, spike, standard, and QC data compared with results for analyses of each batch of samples.
- Reporting of all analytical data for samples with no values rejected as outliers because of the completeness goal of 98% for the analytical support of this project.

APPENDIX D

HEALTH AND SAFETY PLAN

APPENDIX E

**SAMPLING AND ANALYSIS PLAN FOR
THE OFF-SITE INVESTIGATION AREA**

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1 INTRODUCTION

Roy F. Weston, Inc. (WESTON®) was contracted by U.S. Environmental Protection Agency (EPA) Region 6 to perform a remedial investigation and feasibility study (RI/FS) of the State Marine Superfund Site (hereafter referred to as the SMS site) located in Port Arthur, Jefferson County, Texas. WESTON has prepared this Sampling and Analysis Plan (SAP) to support the investigation of the off-site areas in Lake Sabine adjacent to both the State Marine Superfund Site and the Palmer Barge Site (hereafter referred to as the off-site investigation area). This SAP is composed of both a field sampling plan (FSP) and an accompanying quality assurance project plan (QAPP). The FSP describes the details of the field activities associated with collection of environmental samples and other information and will serve as a guide to field personnel.

1.1 OBJECTIVES OF THE INVESTIGATION

The primary objectives of the SAP are the following:

- Characterize the vertical and lateral extent of sediment contamination in the off-site investigation area.
- Characterize the water quality directly adjacent to the shoreline to determine groundwater or sediment porewater contribution to contaminant loading in Sabine Lake.

These objectives will be achieved by evaluating data obtained from laboratory analyses of field collected samples including sediment and water quality. Specifically, sediment and water samples will be collected from specific locations in the off-site investigation area and at a location from a reference area within Sabine Lake adjacent to Sydnese Island to determine if historical or ongoing releases from the site pose a current or future risk to aquatic receptors.

1.2 SCOPE OF WORK

The SAP is designed to guide field and laboratory personnel in collecting and analyzing environmental samples that will support the screening-level ecological risk assessment. Data are

also intended to support other critical elements of the RI/FS including estimation of volumes requiring cleanup and development of potential cleanup levels.

Surface and subsurface sediment will be sampled throughout the off-site investigation area to determine the sediment quality adjacent to the SMS site. Surface sediment data will also be used to determine if risks to the benthic community are significant. Water quality data will be used to estimate potential risks to aquatic receptors such as fish and aquatic invertebrates.

1.3 SAMPLING AND ANALYSIS PLAN FORMAT

The SAP is organized according to the following format

- Section 1—Introduction.
- Section 2—Sampling Design
- Section 3—Sediment Investigation
- Section 4—Surface Water Investigation
- Section 7—Procedures Common to All Field Investigations

2 SAMPLING DESIGN

The sampling design that will be applied to the SMS site to address nearshore sediment contamination is discussed in this section. Sampling methods, locations, quality assurance (QA) procedures, and the analytical approach that will be used during the RI/FS are discussed for each medium in the following sections.

The off-site investigation area for the SMS site was divided into three subareas: intertidal, nearshore, and offshore. The intertidal area represents exposed sediments from the top of the bank along the shoreline to approximately the mean lower low water mark. The nearshore area is irregular in shape and encompasses both shallow sediments and those close to potential upland or on-site sources. The offshore area is a rectangular of about 150 to 200 feet wide paralleling the navigation channel and representing the area most heavily influenced by ship traffic.

Following stratification of the off-site investigation area, a statistically based method was used to estimate the number of samples needed to appropriately characterize surface sediments from all of the subareas. This method was based on the 1986 EPA document, *Test Methods for Evaluating Solid Waste*. Existing surface sediment chemistry data sampled adjacent to the Palmer Barge Site (WESTON, 2000) was used to calculate the mean and variability associated with each constituent that exceeded its respective sediment screening benchmark value. For details on the sediment chemistry, see the WESTON document, *Risk Assessment Work Plan for Palmer Barge*, prepared in 2000.

The number of additional samples required to characterize sediments in the off-site investigation area was calculated based on these metrics relative to the target concentration of interest (in this case, the lowest sediment screening benchmark value). Calculation of additional samples required to adequately characterize surface sediments ranged from 1 sampling location (anthracene, chrysene, fluoranthene, naphthalene) to 392 (manganese) sampling locations. All constituents (excluding manganese) had sampling densities below arsenic, calculated for 52 additional locations. Because sampling 392 additional locations would not be feasible, WESTON proposes a sampling density of 59 samples for the off-site area including:

SAMPLING DESIGN

- 13 intertidal samples.
- 34 nearshore (adjacent to potential source areas) samples.
- 12 offshore (adjacent to shipping channel) samples.

This density will adequately characterize the majority of constituents in off-site surface sediments.

Following statistical evaluation of existing surface sediment data, approximate locations of candidate sampling sites in the subtidal portions of the site were identified using the Fully Integrated Environmental Location Decision Support (FIELDS) System Tools (EPA, 2000). WESTON specifically used the Aligned Systematic Sampling Design (ASSD) Tool to select potential sampling locations in the nearshore and offshore subareas based on the proposed number of additional samples as listed above. The ASSD Tool can be used when the maximum number of samples is known (as in the PB/SM Site) or when there is a pre-determined distance between samples. Results for the nearshore subarea indicate that the 34 additional sampling locations would generate a grid spacing of 123 feet by 123 feet; sufficient to characterize the nearshore sediment without missing any areas of high contamination (hotspots) of approximately 15,000 square feet. Preliminary results indicate that the 12 additional offshore sampling locations would generate grid spacing of 126 feet by 126 feet; sufficient to characterize offshore sediments without missing any hotspots of approximately 15,800 square feet. Upon review of the FIELDS and ASSD results, the sampling locations were modified in the area immediately adjacent to the shoreline to ensure that all potential source area impacts on sediment were accounted for.

Sediment samples from the intertidal subarea will be based on composites of bank materials with similar characteristics. Samples will be collected from available sediments at the toe of the bank to represent material that may be eroding into Lake Sabine. Actual shoreline composite areas will be determined in the field and will be based on areas with similar physical features and source characteristics.

SAMPLING DESIGN

Figure 2-1 depicts the proposed sampling locations for the intertidal, nearshore, and offshore subareas. It should be noted that some sample locations may not be accessible due to obstructions and therefore the proposed number of locations may be reduced.

Sediments representing reference conditions (background locations) in Lake Sabine will be collected near Sydnese Island (see Figure 2-2). A total of five background samples from the reference area will be sampled and measured for the same criteria as those in the off-site investigation area.

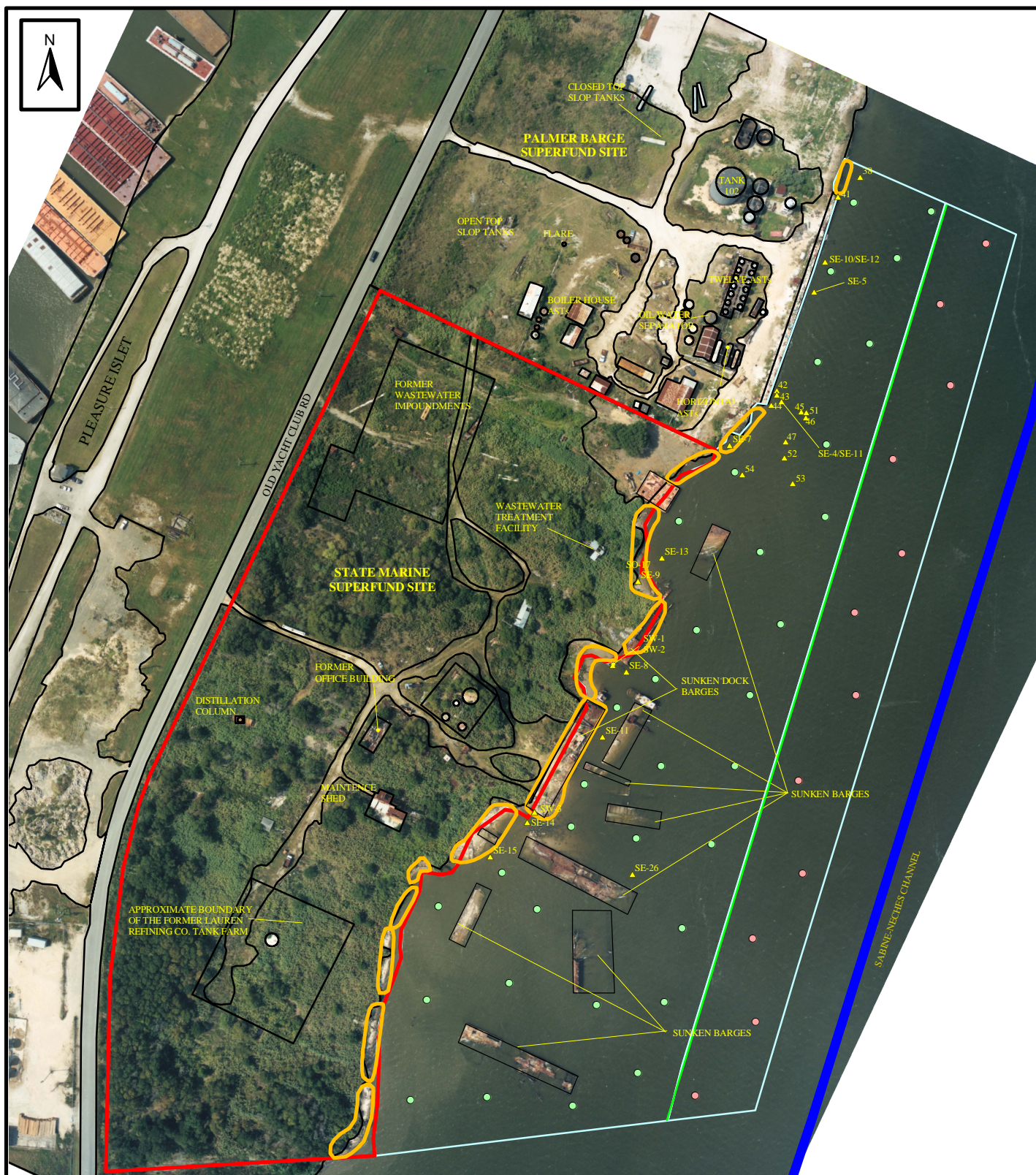
Surface (top 10 cm) sediment samples from the top 10 centimeters (cm) will be collected from each of the proposed locations within the off-site investigation area and reference area and will be analyzed for inorganic and semi-volatile organic contaminants of concern, along with percent moisture and total organic carbon (TOC). Special inorganic analyses will include bulk tributyltin (TBT) and acid volatile sulfide/simultaneously extractable metals (AVS/SEM). Surface sediment samples will also be screened in the field to document approximate grain size for locating an appropriate reference area.

Subsurface sediment samples will be collected at approximately 15 sampling locations. Subsurface sediment samples will be collected using a vibracorer or similar push probe sampling technology. If a vibracore sampler is used, samples will be sectioned into 2-foot intervals (from 0 to 4 feet) and archived (frozen) until surface sediment results are available. If a push probe sampler is used, samples will be collected from one interval (0 to 1 foot) and archived. Subsurface sediments will be analyzed based on the result of the co-located surface sample (if the surface sample exceeds sediment screening criteria, the subsurface interval(s) will be evaluated). Subsurface sediments will not be collected in the off-site reference area. Subsurface sediment will be analyzed for the same parameters as surface sediment.

Water quality samples will be collected from approximately 10 sampling locations in the off-site investigation area focusing on those nearshore stations that are adjacent to the shoreline. Samples will be collected from approximately 0.5 meters from the bottom and analyzed for inorganic and semi-volatile organic compounds. Inorganic analyses will include TBT as well as filter and non-filtered samples at every location. Conventional water quality parameters (pH,

SAMPLING DESIGN

dissolved oxygen, salinity, turbidity, temperature, and conductivity) will also be measured at 1-meter depth intervals from the surface to the bottom at each station to aid in interpreting the water quality sampling results. A total of 5 background samples will also be collected from the reference area adjacent to Sydnese Island. Surface water background samples will be analyzed for the same parameters as in the off-site investigation area.



LEGEND

- PROPOSED OFFSHORE SAMPLING LOCATIONS
- PROPOSED NEARSHORE SAMPLING LOCATIONS
- ▲ HISTORICAL SAMPLING LOCATIONS
- PROPOSED INTERTIDAL SAMPLING AREAS
- NEARSHORE/OFFSHORE DIVISION BOUNDARY
- STATEMARINE SUPERFUND SITE PROPERTY BOUNDARY
- SAMPLING AREA BOUNDARY

0 100 200 300 Feet

SOURCE: AERIAL VIEWPOINT
P.O. BOX 692075-294
HOUSTON, TX 77269

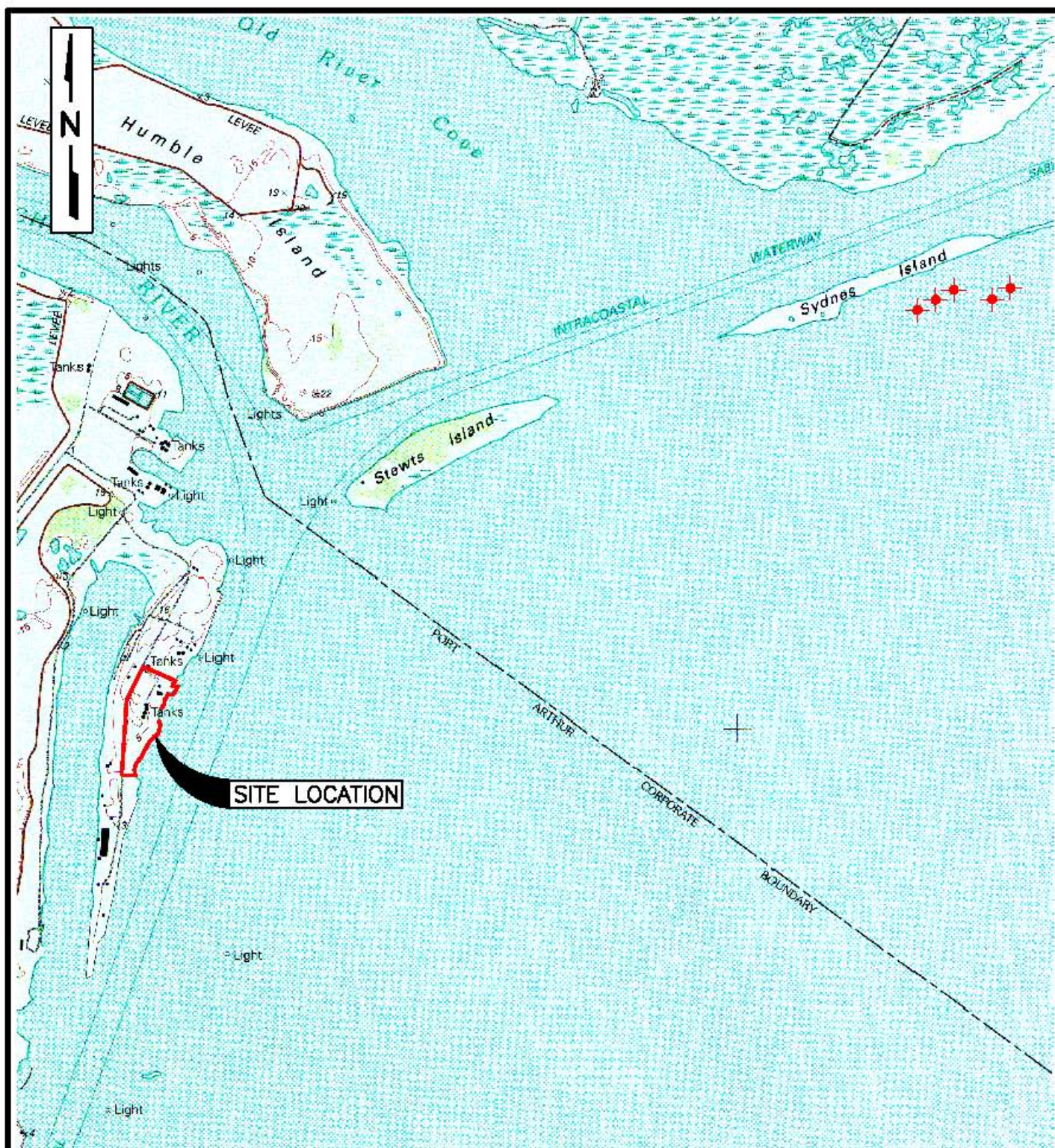
WESTON
MANAGERS DESIGNERS/CONSULTANTS

FIGURE 2-1
STATE MARINE SUPERFUND SITE
USEPA REGION 6
CERCLA ID NO. TXD099801102
PROPOSED OFF-SITE
SAMPLING LOCATIONS
PORT ARTHUR, JEFFERSON COUNTY,
TEXAS

DATE
JUL 01

PROJECT NO.
20074.515.012.9989

SCALE
AS SHOWN



LEGEND:



SEDIMENT SAMPLE LOCATION

0 1000 2000

SCALE IN FEET
(APPROXIMATE)

SOURCE:

US GEOLOGICAL SURVEY, PORT ARTHUR NORTH
QUADRANGLE, 7.5 MINUTE SERIES (TOPOGRAPHIC),
AND WEST OF GREENS BAYOU QUADRANGLE, TEXAS-
LOUISIANA, 1993.

CERCLA ID NO. TXD099801102

WESTON
ENGINEERS ARCHITECTS CONSULTANTS

FIGURE 2-2 STATE MARINE SUPERFUND SITE

US EPA REGION 6
OFFSITE BACKGROUND
SAMPLE LOCATION MAP
REMEDIAL INVESTIGATION
FEASIBILITY STUDY

PORT ARTHUR, JEFFERSON COUNTY, TEXAS

DATE

JAN 01

PROJECT NO.

20074515012

SCALE

AS SHOWN

3 SEDIMENT INVESTIGATION

3.1 SAMPLING LOCATIONS

Surface (0 to 10 cm) sediment samples will be collected from all 59 locations between the SMS site shoreline and the main shipping channel. Subsurface samples (0 to 4 feet) will be collected at approximately 10 of the sediment sampling locations. The proposed locations of the sediment samples are shown in Figure 2-1. If a proposed sampling location cannot be accessed because of obstructions or other sampling difficulties, the station will be relocated as close as possible to the target location and the new coordinates will be noted in the field logbook.

An area in Lake Sabine will be used as the reference location for this investigation (see Figure 2-2). Sydnese Island has been selected as the reference area to represent regional conditions at the site without significant anthropogenic impacts. Sydnese Island was selected as the reference area during the June 25, 2000 SMS Meeting with WESTON and EPA. Five surface sediment samples with similar grain size characteristics to the off-site investigation area will be collected in the vicinity of Sydnese Island.

3.2 SAMPLING METHODS

3.2.1 Intertidal Sediment

Thirteen separate segments will be sampled along the shoreline of the SMS site (Figure 2-1 shows the approximate location). Samples will be composed of surface samples collected from the toe of the bank defining the shoreline. This area is anticipated to be more representative of materials eroding from the bank and exposing aquatic organisms. Actual composite areas will be determined in the field based on similarity of sediment characteristics, elevation, and relationship to source areas.

A transect will be laid parallel to the toe of the bank in each area to be sampled. Transects may range from 100 to 200 feet in length. Sample locations along the transect will be randomized by selecting 10 to 20 numbers between 1 and n (where n equals the total length of the transect). The

SEDIMENT INVESTIGATION

numbers selected will represent distance from the starting point of the transect. The overall goal is to have a number of subsamples per transect that would average every 10 feet (200 feet/10 feet = 20 subsamples). Surface sediments will be collected using a stainless steel hand trowel at the distances from the origin indicated by the random numbers. Each subsample will be added to a large stainless steel bowl or soup pot and thoroughly homogenized before filling containers for analyses. Sediment characteristics (color, odor, apparent grainsize, presence of debris or garbage, depth to redox layer, and presence of organisms) in the sampling areas will be recorded in the field log as well as the distance from the origin of the transect. Other information such as date, time, estimate of tidal elevation, sampling crew, and weather will also be logged. Samples will be preserved on ice for laboratory analyses.

3.2.2 Surface Sediment

Surface sediment for chemical testing will be collected in accordance with American Society for Testing and Materials (ASTM) protocols from 46 locations in the off-site investigation area (34 nearshore and 12 offshore) and at 5 locations in the reference area. Samples will be collected using a stainless-steel modified 0.1 square meter (m^2) vanVeen, Ponar, or Ekman Dredge sampler (or similar equipment) using a hydraulic/motor-powered or hand-cranked hoisting system. A hydraulic/motor-powered hoisting system is preferable. The hoisting system preferably mounted on the stern of the vessel, should provide surface sediment samples in a timely manner. The descent speed of the sampler will be controlled by personnel on-board to minimize the probability of improper orientation upon contact with bottom. Depth to sediment, station coordinates, and time will be recorded at the moment the grab sampling device contacts the bottom. The grab sampler will be retrieved at a rate of speed that will minimize potential disturbance of the sediment surface within the sampler.

Upon retrieval, the sampler will be placed in an onboard table stand and braced in an upright position using wooden blocks. The access flaps will be opened and the overlying water will be slowly removed using a siphon. If excessive water leakage is evidenced by lack of an overlying water layer or excessive water turbidity is observed, the sample will be rejected prior to any additional characterization. For grab samples initially accepted based on minimal water leakage

SEDIMENT INVESTIGATION

and turbidity, the condition of the collected sediment will be visually characterized per the following criteria to determine overall sample acceptability.

- Sediment is not pressed against the inside top or extruding from the sampler.
- Sediment surface appears to be relatively undisturbed (i.e., flat with minimal winnowing).
- Minimum penetration depths are achieved:
 - Medium-coarse sand - 4 to 5 cm
 - Fine sand - 6 to 7 cm
 - Silts/clays - 10 cm

Samples that do not meet any one of the above criteria will be rejected and the station re-sampled. Locations at which a 10-centimeter penetration depth cannot be consistently obtained will be represented by the maximum obtainable depth. Corrective actions that may be implemented in the field to address potential sampler overfilling or consistent under-penetration include the removal of weights or addition of buoys to the sampling device, or adding weights to the van Veen, to address the former and latter problems, respectively.

After a grab sample is deemed acceptable, the following observations will be recorded on the field sample record forms:

- Sediment penetration depth (nearest 0.5 cm) based on sediment depth at the center of the grab.
- Physical characteristics of the surface sediment, including color, texture, and presence and types of biological structures, debris, sheens, or odors.
- Physical characteristics of the vertical profile, including changes in sediment characteristics and presence and depth of potential redox layer.

The top 10 centimeters of the sediment will be removed from the van Veen grab sampler using decontaminated stainless-steel spoons or trowels and placed in stainless-steel bowls for compositing and homogenization. Care will be taken to ensure that sediment in contact with the inside of the sampler, as well as any large items of debris, are excluded from the samples for

laboratory analysis. The sediments will be thoroughly homogenized to a consistent color and texture prior to subsampling for chemistry.

3.2.3 Subsurface Sediment

Shallow (1 to 4 feet below mudline) subsurface sediment samples will be collected using a vibracoring or similar push probe device operated from a sampling vessel. Since limited offshore soil information is available, WESTON feels that vibracoring technology will provide the most reliable core recoveries to the desired depths. This is due to the fact that vibratory coring is generally more effective for pushing through stiff layers such as confining clays without “plugging off.” For a vibracoring device, unlined aluminum core tubes will be driven into the sediment by a hydraulic system with a remotely operated vibrating hammer assembly. A stainless-steel core cutter/catcher will be used to retain a continuous sediment sample within the core tube. The vibrating drive head assembly and core tubes are mounted on an A-frame, which is deployed overboard. The base of the vibracoring device will be adjusted, as necessary, to allow for the device to sit level on the bottom. Once the device is deployed and stabilized, vibracoring will begin. Actual coring depths will vary based on the thickness of potentially contaminated sediment. It is anticipated that sediment cores will be collected to a depth of 1 to 4 feet below mudline depending on the type of coring system used. It is important to note that an alternative sampling technique to vibracoring may be used depending on the type of material encountered.

When a desired penetration depth has been achieved or considerable resistance encountered in the core, the coring device will be retrieved onboard. The coring tube will be removed and the bottom end will be capped. The depth to sediment from the top of the coring tube will be measured and recorded. In addition, depth to sediment from the bottom of the coring tube will be measured and recorded. Visual classifications of the sediment at each end of the core tube sections will be made and recorded, and each end will be capped with aluminum foil and sealed with duct tape. Core tube sections from each location will be stored upright in large barrels or tubs with ice onboard.

SEDIMENT INVESTIGATION

At the processing location, sediment will be extruded from the core tubes by elevating the tube at an angle and tapping the tube with a mallet or vibrating the core tube. The subsurface sediment will be placed on decontaminated stainless-steel trays as it is being extruded. A qualified geologist will visually characterize the extruded sediment prior to compositing for chemical analyses. The following observations will be recorded on the field logs:

- Estimated percent recovery.
- Physical characteristics, including color, texture, density, and presence and types of biological structures, debris, sheens, or odors.
- Vertical profile characteristics, including stratification and lenses.

The sediment compositing scheme will be based primarily on compositing sediments from one sample (0 to 1 foot) or two samples of 2-foot lengths each (0 to 4 feet); depending on how deep a core could be obtained. Minor adjustments to final composite intervals may be expected during processing based on visual determinations of substantial changes in substrate characteristics. Once the core subsections for compositing are determined, each subsection will be split longitudinally and sediment removed for homogenization in decontaminated stainless-steel bowls prior to placement in sampling jars for chemical analyses.

Efforts will be taken prior to processing to avoid losing pore water if the cores are subsectioned into 2-foot lengths. Cores will be securely sealed at both the top and the bottom to prevent loss of pore water, overlying water, or both. After a subsectioning cut is made to a given core, the bottom end of the subsection will be immediately covered using a Teflon core cap and sealed with duct tape. It is anticipated that some of the overlying water of the core will be unavoidably lost. Consequently, site water will be used to "top off" cores before the top of the core is sealed in an effort to minimize any air/water interface. Cores will be stored at or near in situ temperature as measured at the time of collection. Efforts will be made to maintain all subsectioned cores at 45 degrees to upright for storage to minimize disturbance to sediment.

All field observations made during coring and processing of subsectioned cores will be entered into a core description log.

3.2.4 Quality Assurance and Control Samples

Split field samples (i.e., additional sediment from a sample composite) will be collected at approximately 10% of the locations to represent the contribution of sample handling and analysis to analytical variability. An additional 10% of the samples collected will be replicated (i.e., additional sediment from a co-located composite sample) and analyzed to represent field variability.

3.3 LABORATORY METHODS

Analytical requirements for each off-site sampling location are provided in Table 3-1 and are summarized in text, below. All surface and subsurface sediment samples will be analyzed for the Target Analyte List (TAL) inorganics and the Target Compound List (TCL) semi-volatile organic compounds (SVOCs) as identified in Table 3-2. Tributyltin in the ion form, will also be analyzed in all surface and subsurface sediment samples. Acid volatile sulfide/simultaneously extractable metals (AVS/SEM) will only be analyzed in surface sediment samples. Conventional parameters (total organic carbon and percent moisture) will be analyzed in surface sediments to aid in the interpretation of the chemical results.

3.3.1 Sediment Quality

A comprehensive list of analytes, suggested analytical methods to be used, and quantitation limit goals (both CLP and PRQL) for the off-site sediment investigation are presented in Table 3-2.

3.3.1.1 Physical Parameters

Gravimetric Percent Moisture

The gravimetric moisture content will be determined in accordance with ASTM method D-2216 on samples submitted for TOC analysis. Moisture content will be reported as percent water on a dry weight basis to the nearest percent. Gravimetric moisture content (i.e., dry weight, total solids) is used to normalize analytical results to a dry mass of material. Sediments results reported on a wet-weight basis may vary widely depending upon the amount of moisture present.

Grain Size

Grain size determinations will be made on all surface samples in off-site investigation area during the field investigation using wet sieving techniques. There will be no laboratory analysis of grain size at this time. Results of the wet sieving analysis will be documented in the daily logbook so that similar reference area sediments can be located and sampled adjacent to Sydnese Island.

3.3.1.2 Conventional Sediment Parameters

Total Organic Carbon

Suggested analysis for total organic carbon (TOC) will be performed using PSEP protocols (1986 with updates) and modifications recommended by Michelsen (1992). Samples will be pretreated with dilute hydrochloric acid to remove inorganic carbon (mainly as metal carbonates) prior to analysis. Samples will be oxidized at approximately 850° C and the carbon dioxide formed will be measured via infrared spectrophotometry. Results will be reported as milligrams of carbon per kilogram dry weight of the unacidified sample.

3.3.1.3 Sediment Chemical Analyses

Metals

Analysis for metals including TBT and AVS/SEM will be determined according to the suggested methods as outlined in the Scope of Work (SOW) for analytical services presented as Attachment E-1. It is important to note that these methods may be different from those used recommended by individual laboratories to achieve the site-specific project-required quantitation limits (PRQLs).

Semi-Volatile Organic Compounds

Analysis for SVOCs including pentachlorophenol and polyaromatic hydrocarbons (PAHs) will be determined according to the suggested methods as outlined in the Scope of Work (SOW) for analytical services (see Attachment E-1). It is important to note that these methods may be

SEDIMENT INVESTIGATION

different from those used recommended by individual laboratories to achieve the site-specific PRQLs.

Volatile organic, polychlorinated biphenyl (PCB), and pesticide compounds will not be analyzed in sediments as part of this phase of work.

Reference Sediment

Reference area sediment will be collected and concurrently tested with each chemical test to provide a basis for comparison of ambient and site-related conditions. Reference area sediment will be collected from Sydnese Island (see Figure 2-2). Locations within the reference area will be selected based on depths and field-tested grain sizes similar to those observed at locations from the off-site investigation area. This field test, the only grain size test that will be conducted, will help limit potential effects due to physical differences between sediments.

SEDIMENT INVESTIGATION

Table 3-1

Proposed Sampling and Analysis Summary

Station ^a	PROPOSED ANALYSES				
	Sediment Quality			Surface Water Quality	
	Surface Chemistry ^b	Subsurface Chemistry ^c	Physical/Conventional ^d	Chemistry ^e	Physical/Conventional ^f
Intertidal					
PB001	X		X		
PB002	X		X		
SM001	X		X		
SM002	X		X		
SM003	X		X		
SM004	X		X		
SM005	X		X		
SM006	X		X		
SM007	X		X		
SM008	X		X		
SM009	X		X		
SM010	X		X		
SM011	X		X		
Nearshore					
PB003	X	X	X		
PB004	X	X	X		
PB005	X	X	X		
PB006	X	X	X		
PB007	X	X	X		
PB008	X		X		
PB009	X		X		
PB010	X		X		
SM012	X		X		
SM013	X		X		
SM014	X		X		
SM015	X		X		
SM016	X	X	X	X	X
SM017	X	X	X	X	X
SM018	X	X	X	X	X
SM019	X	X	X	X	X

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SEDIMENT INVESTIGATION

Table 3-1 (Continued)

Proposed Sampling and Analysis Summary

Station ^a	PROPOSED ANALYSES				
	Sediment Quality			Surface Water Quality	
	Surface Chemistry ^b	Subsurface Chemistry ^c	Physical/Conventional ^d	Chemistry ^e	Physical/Conventional ^f
SM020	X	X	X	X	X
SM021	X	X	X	X	X
SM022	X	X	X	X	X
SM023	X	X	X	X	X
SM024	X	X	X	X	X
SM025	X	X	X	X	X
SM026	X		X		
SM027	X		X		
SM028	X		X		
SM029	X		X		
SM030	X		X		
SM031	X		X		
SM032	X		X		
SM033	X		X		
SM034	X		X		
SM035	X		X		
SM036	X		X		
SM037	X		X		
Offshore					
PB011	X		X		
PB012	X		X		
PB013	X		X		
PB014	X		X		
SM038	X		X		
SM039	X		X		
SM040	X		X		
SM041	X		X		
SM042	X		X		
SM043	X		X		
SM044	X		X		
SM045	X		X		

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SEDIMENT INVESTIGATION

Table 3-1 (Continued)

Proposed Sampling and Analysis Summary

	PROPOSED ANALYSES				
	Sediment Quality			Surface Water Quality	
Station ^a	Surface Chemistry ^b	Subsurface Chemistry ^c	Physical/Conventional ^d	Chemistry ^e	Physical/Conventional ^f
Reference					
RF001	X		X	X	X
RF002	X		X	X	X
RF003	X		X	X	X
RF004	X		X	X	X
RF005	X		X	X	X

Notes:

a: First two characters of station label identify the general area; PB=Palmer Barge, SM=State Marine, RF=Reference; the last three characters account for the station number within that area.

b: Surface chemistry analysis will include SVOCs, TAL metals, AVS/SEM, and TBT from 0 to 0.5 feet.

c: Subsurface chemistry analysis will include SVOCs, TAL metals, and TBT from 0 to 4 feet.

d: Physical and conventional sediment analyses will include gravimetric percent moisture and TOC from all surface sediment locations.

e: Surface water chemistry will include SVOCs, TAL metals, and TBT.

f: Physical and conventional analyses for surface water will include temperature, pH, conductivity, salinity, DO, and turbidity.

TAL = Target Analyte List

AVS/SEM = Acid Volatile Sulfide/Simultaneously Extractable Metals

SVOC = Semi-Volatile Organic

TBT = Tributyltin

TOC = Total Organic Carbon

DO = Dissolved Oxygen

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Table 3-2

Target Analytes, Methods of Analysis, and Quantitation Limit Goals for Sediment

Analyte	EPA CRQLs or CRDLs ^{(a),(d)}	SITE-SPECIFIC PRQLs ^{(b),(d)}	Basis for PRQL	Suggested PRQL Reference Method	CRQL or CRDL Exceeds Site-Specific PRQLs
Conventionals					
AVS/SEM ^(c)	NA	NA	--	EPA (1991)	--
Gravimetric water content (%)	NA	NA	--	ASTM D2216	--
Total organic carbon (ppm)	NA	200	--	9060-PSEP modification	--
SVOCs (ug/kg)					
1,1'-biphenyl ^(e)	330	29210	Human Health	EPA 8270 - Low Level	NO
2,2'-oxybis(1-chloropropane) ^(e)	330	9	Human Health	EPA 8270 - Low Level	YES
2,4,5-trichlorophenol	830	76951	Human Health	EPA 8270 - Low Level	NO
2,4,6-trichlorophenol	330	196	Human Health	EPA 8270 - Low Level	YES
2,4-dichlorophenol	330	2309	Human Health	EPA 8270 - Low Level	NO
2,4-dimethylphenol	330	29	Ecological	EPA 8270 - Low Level	YES
2,4-dinitrophenol	830	1539	Human Health	EPA 8270 - Low Level	NO
2,4-dinitrotoluene	330	1539	Human Health	EPA 8270 - Low Level	NO
2,6-dinitrotoluene	330	770	Human Health	EPA 8270 - Low Level	NO
2-chloronaphthalene	330	29273	Human Health	EPA 8270 - Low Level	NO
2-chlorophenol	330	295	Human Health	EPA 8270 - Low Level	YES
2-methylnaphthalene	330	70	Ecological	EPA 8270 - Low Level	YES
2-methylphenol	330	63	Ecological	EPA 8270 - Low Level	YES
2-nitroaniline	830	46	Human Health	EPA 8270 - Low Level	YES
2-nitrophenol	330	615523	Human Health	EPA 8270 - Low Level	NO
3,3'-dichlorobenzidine	330	5	Human Health	EPA 8270 - Low Level	YES
3-nitroaniline	830	175739	Human Health	EPA 8270 - Low Level	NO
4,6-dinitro-2-methylphenol	830	62916	Human Health	EPA 8270 - Low Level	NO
4-Bromophenyl-phenylether	330	1180	Human Health	EPA 8270 - Low Level	NO
4-chloro-3-methylphenol	330	3180115	Human Health	EPA 8270 - Low Level	NO
4-chloroaniline	330	3078	Human Health	EPA 8270 - Low Level	NO
4-chlorophenyl-phenyl ether	330	975	Human Health	EPA 8270 - Low Level	NO
4-methylphenol	330	670	Ecological	EPA 8270 - Low Level	NO
4-nitroaniline	830	502035	Human Health	EPA 8270 - Low Level	NO
4-nitrophenol	830	6156	Human Health	EPA 8270 - Low Level	NO
Acenaphthene	330	16	Ecological	EPA 8270 - Low Level	YES
Acenaphthylene	330	44	Ecological	EPA 8270 - Low Level	YES
Acetophenone ^(e)	330	2.022	Human Health	EPA 8270 - Low Level	YES
Anthracene	330	85	Ecological	EPA 8270 - Low Level	YES
Atrazine ^(e)	330	10	Human Health	EPA 8270 - Low Level	YES
Benzaldehyde ^(e)	330	373	Human Health	EPA 8270 - Low Level	NO
Benzo(a)anthracene	330	2.637	Human Health	EPA 8270 - Low Level	YES
Benzo(a)pyrene	330	0.264	Human Health	EPA 8270 - Low Level	YES

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SEDIMENT INVESTIGATION

Table 3-2 (Continued)

Target Analytes, Methods of Analysis, and Quantitation Limit Goals for Sediment

Analyte	EPA CRQLs or CRDLs ^{(a),(d)}	SITE-SPECIFIC PRQLs ^{(b),(d)}	Basis for PRQL	Suggested PRQL Reference Method	CRQL or CRDL Exceeds Site-Specific PRQLs
Benzo(b)fluoranthene	330	2.637	Human Health	EPA 8270 - Low Level	YES
Benzo(g,h,i)perylene	330	670	Ecological	EPA 8270 - Low Level	NO
Benzo(k)fluoranthene	330	3.200	Ecological	EPA 8270 - Low Level	YES
Bis(2-chloroethoxy)methane	330	87	Human Health	EPA 8270 - Low Level	YES
Bis(2-chloroethyl)ether	330	0.694	Human Health	EPA 8270 - Low Level	YES
bis(2-ethylhexyl)phthalate	330	154	Human Health	EPA 8270 - Low Level	YES
Butylbenzylphthalate	330	240	Human Health	EPA 8270 - Low Level	YES
Caprolactam ^(c)	330	100000	Human Health	EPA 8270 - Low Level	NO
Carbazole ^(c)	330	108	Human Health	EPA 8270 - Low Level	YES
Chrysene	330	57	Ecological	EPA 8270 - Low Level	YES
Dibenzo(a,h)anthracene	330	0.264	Human Health	EPA 8270 - Low Level	YES
Dibenzofuran	330	540	Ecological	EPA 8270 - Low Level	NO
Diethylphthalate	330	100000	Human Health	EPA 8270 - Low Level	NO
Dimethylphthalate	330	100000	Human Health	EPA 8270 - Low Level	NO
Di-n-butylphthalate	330	1400	Ecological	EPA 8270 - Low Level	NO
Di-n-octylphthalate	330	15390	Human Health	EPA 8270 - Low Level	NO
Fluoranthene	330	111	Ecological	EPA 8270 - Low Level	YES
Fluorene	330	19	Ecological	EPA 8270 - Low Level	YES
Hexachlorobenzene	330	1.347	Human Health	EPA 8270 - Low Level	YES
Hexachlorobutadiene	330	11	Ecological	EPA 8270 - Low Level	YES
Hexachlorocyclopentadiene	330	5220	Human Health	EPA 8270 - Low Level	NO
Hexachloroethane	330	154	Human Health	EPA 8270 - Low Level	YES
Indeno(1,2,3-cd)pyrene	330	2.637	Human Health	EPA 8270 - Low Level	YES
Isophorone	330	2268	Human Health	EPA 8270 - Low Level	NO
Naphthalene	330	160	Ecological	EPA 8270 - Low Level	YES
Nitrobenzene	330	129	Human Health	EPA 8270 - Low Level	YES
N-nitroso-di-n-propylamine	330	0.308	Human Health	EPA 8270 - Low Level	YES
N-nitrosodiphenylamine	330	28	Ecological	EPA 8270 - Low Level	YES
Pentachlorophenol	830	11	Human Health	EPA 8151 - modified	YES
Phenanthrene	330	42	Ecological	EPA 8270 - Low Level	YES
Phenol	330	420	Ecological	EPA 8270 - Low Level	NO
Pyrene	330	53	Ecological	EPA 8270 - Low Level	YES
Metals (mg/kg)					
Aluminum	40	100000	Human Health	EPA 6010A	NO
Antimony	12	511	Human Health	EPA 6010A	NO
Arsenic	2	8	Ecological	EPA 7060A	NO
Barium	40	83227	Human Health	EPA 7421	NO
Beryllium	1	2426	Human Health	EPA 6010A	NO
Cadmium	1	634	Human Health	EPA 6010A	NO

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SEDIMENT INVESTIGATION

Table 3-2 (Continued)

Target Analytes, Methods of Analysis, and Quantitation Limit Goals for Sediment

Analyte	EPA CRQLs or CRDLs ^{(a),(d)}	SITE-SPECIFIC PRQLs ^{(b),(d)}	Basis for PRQL	Suggested PRQL Reference Method	CRQL or CRDL Exceeds Site-Specific PRQLs
Calcium	1,000	NA	Human Health	EPA 6010A	--
Chromium	2	80	Human Health	EPA 6010A	NO
Cobalt	10	29515	Human Health	EPA 6010A	NO
Copper	5	34	Ecological	EPA 6010A	NO
Cyanide	1	19410895	Human Health	EPA 9010B	NO
Iron	20	20000	Ecological	EPA 6010A	NO
Lead	0.6	47	Ecological	EPA 6010A	NO
Magnesium	1,000	NA	--	EPA 6010A	--
Manganese	3	460	Ecological	EPA 6010A	NO
Mercury	0.1	0.15	Ecological	EPA 7471A	NO
Nickel	8	21	Ecological	EPA 6010A	NO
Potassium	1,000	NA	--	EPA 6010A	--
Selenium	1	6388	Human Health	EPA 7740	NO
Silver	2	1.0	Ecological	EPA 6010A	YES
Sodium	1,000	NA	--	EPA 6010A	--
Thallium	2	NA	--	EPA 7841	--
Vanadium	10	8943	Human Health	EPA 6010A	NO
Zinc	4	150	Ecological	EPA 6010A	NO
Organotins (mg/kg)					
Tributyltin ^(f)	NA	0.025	Ecological	Krone (1989)	--

Notes:

- (a) Sources for CRQLs and CRDLs: *Organics* = USEPA Contract Laboratory Program Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration, OLM04.2. May 1999. *Inorganics* = USEPA Contract Laboratory Program Statement of Work for Inorganic Analysis and Classical Chemistry Parameters Multi-Media, Multi-Concentration. Draft ILM05.01D. January 2000.
- (b) PRQLs were based on the following criteria, whichever was lowest: (1) TNRCC Ecological Benchmarks for Marine and Freshwater Sediments. Source: *Guidance for Conducting Ecological Risk Assessments at Remediation Sites in Texas*. Draft Final. August 28, 2000. (2) Puget Sound Apparent Effects Thresholds (AETs). Source: *Barrick, et.al. 1988. Volume 1. Sediment Quality Values Refinement: 1988 Update and Evaluation of Puget Sound AET*. EPA Contract No. 68-01-4341. PTI Environmental Services, Bellevue, WA. (3) TNRCC Tier 1 Industrial PCL (TOT_{SoilComb}) (0.5 acre). Source: *Table 2, Chapter 350, Texas Risk Reduction Program*. (4) EPA Risk-Based Concentrations for Industrial (Outdoor Worker) Soil. Source: *EPA Region 6 Risk-Based Concentration Table (August 2000)*.
- (c) Suggested reference method for AVS/SEM in sediment: *U.S. EPA. Analytical Method for Determination of Acid Volatile Sulfide and Selected Simultaneously Extractable Metals in Sediment*. December 1991. Office of Water, Office of Science and Technology Health and Ecological Division, Washington, D.C.
- (d) EPA CRQLs/CRDLs are expressed on a wet-weight basis; site-specific PRQLs are expressed on a dry-weight basis.
- (e) Reference methods may not be able to achieve desired PRQLs for these analytes.
- (f) The suggested method for tributyltin is in the ion form. The PRQL is based on TBT as tin (Sb) from *Recommendations for Screening Values for Tributyltin in Sediments at Superfund Sites in Puget Sound, Washington*. EPA Region X. Contract No. 68-W9-0046. The suggested referenced method for Krone (1989) = *C.A. Krone, et.al. A Method for Analysis of Butyltin Species and Measurement of Butyltins in Sediment and English Sole Livers from Puget Sound, Marine Environmental Research 27, p. 1-18 1989*. In order to achieve required detection/quantitation limits, GC/MS utilizing selected ion monitoring (GC/MS-SIM), rather than full scan acquisition is necessary.

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Table 3-2 (Continued)

Target Analytes, Methods of Analysis, and Quantitation Limit Goals for Sediment

NA = Indicates that a PRQL, CRQL, or CRDL was not available for this analyte.

CRQL = Contract Required Quantitation Limit for organic analytes.

CRDL = Contract Required Detection Limit for inorganic analytes.

PCL = Protective Concentration Level

PRQL = Project Required Quantitation Limit is lowest value of either the ecological or human health screening benchmark value.

SM = Standard Methods for the Examination of Water and Wastewater

Reference Method = Analytical method required to achieve the project data quality objectives (DQOs).

PSEP = Puget Sound Estuary Program

ASTM = American Society of Testing and Materials

AVS/SEM = Acid Volatile Sulfide/Simultaneously Extractable Metals

Note: This table represents a revision of information from the Final Draft RI/FS Quality Assurance Project Plan (QAPP).

4 SURFACE WATER INVESTIGATION

4.1 SAMPLING LOCATIONS

Surface water samples will be collected at approximately 10 of the sediment sampling locations at the SMS site; see Figure 2-1. Water quality reference sampling will also be conducted at the 5 stations from the reference area; see Figure 2-2.

4.2 SAMPLING METHODS

4.2.1 Water Samples

Water samples will be collected using a water bottle sampling device (e.g., van Dorn, Niskin, Nassen,) that can be triggered to close from onboard the sampling vessel. Once on station, the depth of the water column will be determined. The sampling device will be slowly lowered to approximately 0.5 meters off bottom, and the messenger will be triggered to collect a water sample at that depth. The sampling device will be retrieved and brought aboard. Sample containers will be filled at a rate that will minimize disturbance and potential loss of constituents.

Samples will be preserved according to the criteria outlined by the specified laboratory. Two to three liters of water will be needed for all the analyses. Two bottles will be deployed simultaneously, if required to meet sample volumes. The sampling device will be thoroughly rinsed with distilled water between stations. If a sheen or other contaminating material is encountered, an entire decontamination procedure will be employed prior to reuse of the sampling device.

Conventional water quality parameters will be measured using a multi-parameter probe with onboard instrumentation (e.g., Hydrolab). The instrument will be calibrated at the beginning of each day and will be checked at regular (3 to 4 times) intervals during the day. The probe will be rinsed with distilled water between stations. Measurements of conductivity, dissolved oxygen, temperature, salinity, pH and turbidity will be made at 1 meter intervals from the water surface to 0.5 meters off-bottom.

4.2.2 Quality Assurance and Control Samples

Split field samples (i.e., additional water from a water bottle sampler) will be collected at approximately 10% of the locations to represent the contribution of sample handling and analysis to analytical variability. An additional 10% of the samples collected will be replicated (i.e., additional water from a co-located but separately deployed water bottle) and analyzed to represent field variability.

4.3 LABORATORY PROCEDURES

A sample for chemical analysis will be collected near bottom (within 0.5 meters) to determine the nature and extent of contamination in the water column and to support both the exposure pathways evaluations and risk assessment.

All surface water samples will be analyzed for the full suite of TAL metals and TCL SVOCs as identified in Table 4-1. Tributyltin in the ion form will also be analyzed in surface water. Conventional water quality parameters will be measured at the surface of the water and then at 1 meter increments through the water column. Parameters will include temperature, pH, conductivity, salinity, dissolved oxygen and turbidity.

Table 4-1

Target Analytes, Methods of Analysis, and Quantitation Limit Goals for Surface Water

Analyte	EPA CRQLs or CRDLs ^(a) (µg/L)	Site-Specific PRQLs ^(b) (µg/L)	Basis for PRQLs	Suggested PRQL Reference Method	CRQL or CRDL Exceeds Site-Specific PRQLs
Conventionals ^(c)					
Temperature	NA	NA	--	Hydrolab Multimeter Probe	--
pH	NA	NA	--	Hydrolab Multimeter Probe	--
Conductivity	NA	NA	--	Hydrolab Multimeter Probe	--
Salinity	NA	NA	--	Hydrolab Multimeter Probe	--
Dissolved oxygen	NA	NA	--	Hydrolab Multimeter Probe	--
Turbidity	NA	NA	--	Hydrolab Multimeter Probe	--
SVOCs					
Benzo(a)pyrene	10	0.0044	Human Health	EPA 8270 Low Level	YES
2,4-dinitrophenol	25	6.2	Ecological	EPA 8270 Low Level	YES
Dibenzo(a,h)anthracene	10	0.0044	Human Health	EPA 8270 Low Level	YES
Benzo(a)anthracene	10	0.0044	Human Health	EPA 8270 Low Level	YES
4-chloro-3-methylphenol	10	0.3	Ecological	EPA 8270 Low Level	YES
Hexachloroethane	10	1.9	Human Health	EPA 8270 Low Level	YES
Hexachlorocyclopentadiene	10	0.07	Ecological	EPA 8270 Low Level	YES
Carbazole	10	NA	--	EPA 8270 Low Level	--
1,1'-biphenyl	10	14	Ecological	EPA 8270 Low Level	NO
Acetophenone	10	NA	--	EPA 8270 Low Level	--
Benzaldehyde	10	NA	--	EPA 8270 Low Level	--
Caprolactam	10	NA	--	EPA 8270 Low Level	--
2,2'-oxybis(1-chloropropane)	10	NA	--	EPA 8270 Low Level	--
Atrazine	10	NA	--	EPA 8270 Low Level	--
Isophorone	10	36	Human Health	EPA 8270 Low Level	NO
Accenaphthene	10	23	Ecological	EPA 8270 Low Level	NO
Diethylphthalate	10	88	Ecological	EPA 8270 Low Level	NO
Di-n-butylphthalate	10	5	Ecological	EPA 8270 Low Level	YES

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Table 4-1 (Continued)

Target Analytes, Methods of Analysis, and Quantitation Limit Goals for Surface Water

Analyte	EPA CRQLs or CRDLs ^(a) (µg/L)	Site-Specific PRQLs ^(b) (µg/L)	Basis for PRQLs	Suggested PRQL Reference Method	CRQL or CRDL Exceeds Site-Specific PRQLs
Phenanthrene	10	4.6	Ecological	EPA 8270 Low Level	YES
Butylbenzylphthalate	10	19	Ecological	EPA 8270 Low Level	NO
N-nitrosodiphenylamine	10	5	Human Health	EPA 8270 Low Level	YES
Fluorene	10	2	Ecological	EPA 8270 Low Level	YES
Hexachlorobutadiene	10	0.32	Ecological	EPA 8270 Low Level	YES
Pentachlorophenol	25	0.28	Human Health	EPA 8151M	YES
2,4,6-trichlorophenol	10	2.1	Human Health	EPA 8270 Low Level	YES
2-nitroaniline	25	NA	--	EPA 8270 Low Level	--
2-nitrophenol	10	170	Ecological	EPA 8270 Low Level	NO
Naphthalene	10	23.5	Ecological	EPA 8270 Low Level	NO
2-methylnaphthalene	10	6	Ecological	EPA 8270 Low Level	YES
2-chloronaphthalene	10	1700	Human Health	EPA 8270 Low Level	NO
3,3'-dichlorobenzidine	10	0.04	Human Health	EPA 8270 Low Level	YES
2-Methylphenol	10	112	Ecological	EPA 8270 Low Level	NO
2-chlorophenol	10	52	Ecological	EPA 8270 Low Level	NO
2,4,5-trichlorophenol	25	12	Ecological	EPA 8270 Low Level	YES
Nitrobenzene	10	17	Human Health	EPA 8270 Low Level	NO
3-nitroaniline	25	NA	--	EPA 8270 Low Level	--
4-nitroaniline	25	NA	--	EPA 8270 Low Level	--
4-nitrophenol	25	32	Ecological	EPA 8270 Low Level	NO
4-Bromophenyl-phenylether	10	1.5	Ecological	EPA 8270 Low Level	YES
2,4-dimethylphenol	10	21	Ecological	EPA 8270 Low Level	NO
4-methylphenol	10	54	Ecological	EPA 8270 Low Level	NO
4-chloroaniline	10	NA	--	EPA 8270 Low Level	--
Phenol	10	110	Ecological	EPA 8270 Low Level	NO
Bis(2-chloroethyl)ether	10	0.031	Human Health	EPA 8270 Low Level	YES
Bis(2-chloroethoxy)methane	10	NA	--	EPA 8270 Low Level	--

Table 4-1 (Continued)

Target Analytes, Methods of Analysis, and Quantitation Limit Goals for Surface Water

Analyte	EPA CRQLs or CRDLs ^(a) (µg/L)	Site-Specific PRQLs ^(b) (µg/L)	Basis for PRQLs	Suggested PRQL Reference Method	CRQL or CRDL Exceeds Site-Specific PRQLs
bis(2-ethylhexyl)phthalate	10	1.8	Human Health	EPA 8270 Low Level	YES
Di-n-octylphthalate	10	22	Ecological	EPA 8270 Low Level	NO
Hexachlorobenzene	10	0.00075	Human Health	EPA 8270 Low Level	YES
Anthracene	10	0.06	Ecological	EPA 8270 Low Level	YES
2,4-dichlorophenol	10	36.5	Ecological	EPA 8270 Low Level	NO
2,4-dinitrotoluene	10	0.11	Human Health	EPA 8270 Low Level	YES
Pyrene	10	7	Ecological	EPA 8270 Low Level	YES
Dimethylphthalate	10	330	Ecological	EPA 8270 Low Level	NO
Dibenzofuran	10	13	Ecological	EPA 8270 Low Level	NO
Benzo(g,h,i)perylene	10	NA	--	EPA 8270 Low Level	--
Indeno(1,2,3-cd)pyrene	10	0.0044	Human Health	EPA 8270 Low Level	YES
Benzo(b)fluoranthene	10	0.0044	Human Health	EPA 8270 Low Level	YES
Fluoranthene	10	2.96	Ecological	EPA 8270 Low Level	YES
Benzo(k)fluoranthene	10	0.0044	Human Health	EPA 8270 Low Level	YES
Acenaphthylene	10	NA	--	EPA 8270 Low Level	--
Chrysene	10	0.0044	Human Health	EPA 8270 Low Level	YES
4,6-dinitro-2-methylphenol	25	2.3	Ecological	EPA 8270 Low Level	YES
2,6-dinitrotoluene	10	NA	--	EPA 8270 Low Level	--
N-nitroso-di-n-propylamine	10	0.005	Human Health	EPA 8270 Low Level	YES
4-chlorophenyl-phenyl ether	10	NA	--	EPA 8270 Low Level	--
Metals					
Aluminum	200	87	Ecological	EPA 6010A	YES
Antimony	60	14	Human Health	EPA 6010A	YES
Arsenic ^(d)	10	0.018	Human Health	EPA 7060A	YES
Barium	200	4	Ecological	EPA 6010A	YES
Beryllium ^(d)	5	5.3	Ecological	EPA 6010A	NO

Table 4-1 (Continued)

Target Analytes, Methods of Analysis, and Quantitation Limit Goals for Surface Water

Analyte	EPA CRQLs or CRDLs ^(a) (µg/L)	Site-Specific PRQLs ^(b) (µg/L)	Basis for PRQLs	Suggested PRQL Reference Method	CRQL or CRDL Exceeds Site-Specific PRQLs
Cadmium ^(d)	5	0.6	Ecological	EPA 6010A	YES
Calcium	5,000	NA	--	EPA 6010A	--
Chromium ^(d)	10	NA	--	EPA 6010A	--
Cobalt ^(d)	50	1500	Ecological	EPA 6010A	NO
Copper ^(d)	25	3.1	Ecological	EPA 6010A	YES
Iron	100	1000	Ecological	EPA 6010A	NO
Lead ^(d)	3	1	Ecological	EPA 7421	YES
Magnesium	5,000	NA	--	EPA 6010A	--
Manganese	15	120	Ecological	EPA 6010A	NO
Mercury	0.2	0.0122	Human Health	EPA 7470A	YES
Nickel ^(d)	40	8.2	Ecological	EPA 6010A	YES
Potassium	5,000	NA	--	EPA 6010A	--
Selenium	5	5	Ecological	EPA 7740	NO
Silver ^(d)	10	0.08	Ecological	EPA 6010A	YES
Sodium	5,000	NA	--	EPA 6010A	--
Thallium ^(d)	10	1.7	Human Health	EPA 7841	YES
Vanadium	50	20	Ecological	EPA 6010A	YES
Zinc ^(d)	20	58.1	Ecological	EPA 6010A	NO
Cyanide	10	1	Ecological	EPA 9010B	YES
Butyltins					
Tributyltin ^(e)	NA	0.0240	Ecological	Krone (1989)	--

Notes:

^(a) Sources for CRQLs and CRDLs: *Organics = USEPA Contract Laboratory Program Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration, OLM04.2. May 1999. Inorganics = USEPA Contract Laboratory Program Statement of Work for Inorganic Analysis and Classical Chemistry Parameters Multi-Media, Multi-Concentration. Draft ILM05.0D. January 2000.*

Table 4-1 (Continued)

Target Analytes, Methods of Analysis, and Quantitation Limit Goals for Surface Water

- ^(b) Site-specific PRQLs were based on the following criteria for freshwater and saltwater, whichever was lowest: (1) TNRCC Ecological Benchmarks for Surface Waters. Source: *Guidance for Conducting Ecological Risk Assessments at Remediation Sites in Texas. Draft Final. August 28, 2000.* (2) *Texas Water Quality Standards, Figure: 30 TAC §307.6(c)(1). Aquatic Life Standards.* (3) *National Ambient Water Quality Criteria. EPA-822-F-98-006.* (4) *Texas Surface Water Quality Standards for Human Health, 30TAC307, 30 April 1997.* (5) *EPA National Recommended Water Quality Criteria, 10 December 1998 Federal Register, Human Health Consumption of Water and Organisms.*
- ^(c) Conventional will be measured at all surface water sampling locations starting at 1 meter intervals from the surface to 0.5 meters off-bottom.
- ^(d) Low level detection limits for these analytes includes a reductive precipitation process involving inductively coupled plasma-mass spectrometry (ICPMS).
- ^(e) Suggested method for tributyltin is in the ion form. The PRQL is based on TBT as Sb from *Ambient Aquatic Life Water Quality Criteria for Tributyltin, U.S.EPA Office of Research and Development, Environmental Research Laboratories, Duluth, MN. Final, March 1991.* The suggested referenced method for Krone (1989) = *C.A. Krone, et.al. A Method for Analysis of Butyltin Species and Measurement of Butyltins in Sediment and English Sole Livers from Puget Sound, Marine Environmental Research 27, p. 1-18 1989.* In order to achieve required detection/quantitation limits, GC/MS utilizing selected ion monitoring (GC/MS-SIM), rather than full scan acquisition is necessary.

NA = Indicates that a PRQL, CRQL, or CRDL was not available for this analyte.

CRQL = Contract Required Quantitation Limit for organic analytes.

CRDL = Contract Required Detection Limit for inorganic analytes.

PRQL = Project Required Quantitation Limit is lowest value of either the ecological or human health screening benchmark value.

SM = Standard Methods for the Examination of Water and Wastewater

Reference Method = Analytical method required to achieve the project data quality objectives (DQOs).

Note: This table represents a revision of information from the Final Draft RI/FS Quality Assurance Project Plan (QAPP).

5 PROCEDURES COMMON TO ALL FIELD INVESTIGATIONS

5.1 SAMPLE IDENTIFICATION

All samples collected will be assigned a unique WESTON identification code based on a consistent sample designation scheme designed to suit the needs of the field staff and WESTON's ONLINE data management system. The WESTON codes will not be reported to the laboratory but will be maintained for internal data management use. The WESTON sample designation schemes described below pertain to all potential sample types that may be collected during the course of the off-site investigation, both under the current phase of work and under potential future phases.

The physical location of all stations will be identified by a two letter and three digit identifier (no spaces). The letter identifier (PB, SM, or RF) designates the general area where the station is located (i.e., Palmer Barge, State Marine, or Reference) and the digit identifier the station number within that particular area. The collection type and quality control (QC) type are represented by two digits as follows:

Table 5-1
Collection/Quality Control Type

<u>Collection Type</u>		<u>QC Type</u>	
1	Surface Water	1	Normal
2	Ground Water	2	Duplicate
3	Leachate	3	Rinsate Blank
4	Field QC/Rinsate	4	Trip Blank
5	Soil/Sediment	5	Field Blank
6	Oil	6	Confirmation
7	Waste		
8	Other		
9	Tap Water		

PROCEDURES COMMON TO ALL FIELD INVESTIGATIONS

A sequential sample identifier that represents the n^{th} sample of common collection types is represented by one digit which follows the collection and QC type identifiers. The sediment sample nomenclature is as follows:

Station ID — Collection Type — QC Type — Sequential Sample

Additional qualifiers for each individual sample will be made in the daily off-site investigation field log book to identify such qualifiers as surface or subsurface location and specific depth interval. This information will be hand entered into WESTON's data management system. Additional information regarding the sample nomenclature can be found in SOP 0110.01 presented in Attachment E-2.

Some examples of complete sample numbers with descriptions are as follows:

PB005-51-2 The second normal soil/sediment sample collected at station 005 in the Palmer Barge area.

PB005-52-2 The duplicate of the second normal soil/sediment sample collected at station 005 in the Palmer Barge area.

RF003-51-1 The first normal soil/sediment sample collected at station 003 in the Reference area.

RF003-52-1 The duplicate of the first normal soil/sediment sample collected at station 003 in the Reference area.

5.2 NAVIGATIONAL AND SURVEYING REQUIREMENTS

A differential global positioning system (DGPS) is the proposed surveying system for samples collected from a marine vessel. The DGPS consists of a global positioning system (GPS) receiver mounted at a fixed point (e.g., top of A-frame or sampling platform) on the vessel and a differential receiver located at a horizontal control point. At the control point, the GPS position is compared to the known horizontal location. Offsets or biases are identified and used to develop correction factors, which are sent to the GPS receiver located on the vessel. The GPS receiver sends latitude and longitude coordinates to an integrated navigation system that displays the vessel's position in plan view. Navigation data such as range and bearing from the planned sampling location are provided to guide the positioning of the sampling device relative to the

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target. DGPS is typically accurate to within ± 1 to 3 meters, depending on satellite position. The GPS provides the operator with a listing of time intervals during the day when accuracies are decreased, so these periods can be avoided.

Vertical positioning will also be measured to establish the elevation of the seabed at the sampling locations. Elevations will be established by measuring the vertical distance from the water line to the mudline from a known reference point (e.g., a horizontal positioning control point on top of a pier). Depth to mudline will be measured to the nearest 0.1 foot using a fathometer.

Intertidal sediment sampling may be conducted from the shoreline rather than from a sampling vessel to access under-pier locations. In such cases, land-based surveying techniques will be required. These survey techniques will be based on using the center of the sampling location as the point of reference for determining elevation and position.

The survey procedures for horizontal measurements will be conducted according to the following guidelines:

- The horizontal positions will be determined using specifications promulgated by the Federal Geodetic Control Committee (FGCC). All points will be included in closed traverses or double-tied from points included in a closed traverse.
- Horizontal accuracies will meet an accuracy of plus or minus 3 feet.
- The horizontal datum of reference will be the North American Datum of 1983 (NAD 83), with 1991 adjustment. Coordinates will be reported in the latitude and longitude.

The survey procedures for vertical measurements will be conducted according to the following guidelines:

- Vertical positions will be determined using differential leveling methods. All points will be included in closed circuits or double-tied from points that are included in closed circuits.
- Vertical accuracies will meet or exceed plus or minus 0.2 feet.
- For data evaluation and reporting purposes, the vertical datum of reference will be mean lower low water (MLLW).

PROCEDURES COMMON TO ALL FIELD INVESTIGATIONS

5.3 SAMPLING EQUIPMENT

Equipment decontamination will be required to prevent contamination of clean areas and cross-contamination of samples, and to maintain the health and safety of field personnel.

Decontamination of all sampling equipment will occur prior to sampling. Dedicated or disposable sampling equipment will also be used when feasible to reduce the possibility of sample cross-contamination and decontamination efforts during field activities; however, it is anticipated that some sampling equipment will require repeated decontamination in the field rather than only at the end of each day. Equipment which is likely to require field decontamination includes, but is not limited to:

- Stainless-steel trowels/spoons
- Stainless-steel mixing bowls
- Sediment grab sampler

Equipment that cannot be effectively decontaminated (e.g., siphon tubing) will be disposed of after each sampling event.

The field decontamination procedure for sampling equipment such as those items listed above will consist of the following steps:

1. Alconox detergent wash
2. Tap water rinse
3. Methanol rinse
4. Hexane rinse
5. Methanol rinse
6. Deionized water rinse
7. Air dry away from potential sources of contamination (e.g., splashes)
8. Wrap or cover in aluminum foil (dull side toward covered surface; sampling utensils only)

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Nitrile outer gloves will be scrubbed and rinsed with deionized water before and after handling each sample to minimize cross contamination of samples with phthalate esters from the gloves. In the event gloves are visibly soiled with hydrocarbon-like contamination, they will be disposed of between samples and new gloves will be used.

5.4 SAMPLE HANDLING

5.4.1 Sample Labeling

Sample containers will be labeled and covered with clear tape prior to sampling or labeled immediately after material is placed in the sample container to prevent damage to the sample label from spillage of material during collection. Each label will include the following information, written or typed in permanent ink:

- Sample number
- Date
- Time (24-hour clock)
- Initials of person sampling
- Preservative (if any)
- Requested analyses

5.4.2 Sample Preservation and Holding Times

Samples will be preserved as described in specific analytical procedures presented in the U.S. EPA Contract Laboratory Program (CLP) statements of work for organic and inorganic analyses (EPA, 1990a,b) or in EPA methods for analysis of solid wastes (EPA, 1986) or water and wastes (EPA, 1983). Sample preservation and holding time requirements vary according to analyses and sample matrix and will be confirmed with the specified laboratory prior to shipment.

5.4.3 Sample Containers

Proper sample containers must be used for all analytes to preserve sample integrity. All containers will be precleaned following the requirements in EPA guidance documents (EPA 1989).

PROCEDURES COMMON TO ALL FIELD INVESTIGATIONS

Container requirements vary according to analyte, sample matrix, and hazard classification. It is anticipated that all samples collected for the off-site investigation will be low hazard. The type and number of sample containers that may be required are specified in Table 5-1.

5.4.4 Sample Custody

Sample custody is a critical aspect of environmental investigations, particularly when the data may be used in litigation. The possession and proper handling of samples must be traceable from the time the samples are collected until the time the analytical data have been accepted. In this way, reanalyses may be conducted without concern for possible introduction of contaminants.

The purpose of custody procedures is to provide a documented, legally defensible record that can be used to follow the possession and handling of a sample from collection through analysis. A sample is in custody if it meets at least one of the following conditions:

- Is in someone's physical possession or view
- Is secured to prevent tampering
- Is secured in an area restricted to authorized personnel

Sample control and chain-of-custody procedures in the field and during shipment will be performed in accordance with the procedures in the *Samplers Guide to the Contract Laboratory Program* (EPA, 1990c). These examples represent the minimum amount of information required; other equivalent or more detailed forms may be substituted, provided the minimum requirements are met.

After all samples from a station are collected and labeled, custody tags will be placed around each sample container, and custody seals will be affixed to the container lids in such a manner as to prevent removal of the custody tags and opening of the containers without breaking the seals. In addition, individual sample containers will be placed in resealable plastic bags to prevent cross-contamination in the event of breakage during shipping and handling.

A chain-of-custody record will be completed for each container of samples (i.e., cooler) during the course of the daily sampling activities or at the end of each day of sampling. Custody seals

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will be placed on each cooler containing the samples in such a manner that the cooler cannot be opened without breaking the custody seals. The completed chain-of-custody forms will be delivered to the recipient laboratory with the respective samples.

The QA officer at each laboratory will ensure that the cooler custody seals are unbroken and that the chain-of-custody records completed and signed in the field are properly transferred to the laboratory upon receipt of the samples. Any questions or observations concerning sample integrity will also be noted. The QA officer will ensure that a sample-tracking record is maintained that will follow each sample through all stages of laboratory processing and storage.

5.4.5 Sample Packaging and Shipping Requirements

Packaging, marking, labeling, and shipping of samples will comply with all applicable regulations promulgated by the U.S. Department of Transportation (DOT) in the *Code of Federal Regulations* (49 CFR 171-177) or International Air Transport Association (IATA) regulations, as applicable. Detailed requirements are discussed in the CLP Samplers Guide (EPA, 1990c).

In accordance with the above regulations and guidance, packaging and shipping of off-site samples will be done in a manner that protects both sample integrity and the shipment handlers from the possible hazardous nature of samples. Individual sample containers will be placed in resealable plastic bags. These individual packages will then be placed in polyethylene liner bags in an appropriate shipping container (steel-belted cooler). Sufficient vermiculite will be added to the polyethylene bag to prevent breakage of sample containers and to absorb spills in the event of breakage. Double-bagged ice will be placed on top of the vermiculite for sample preservation purposes. The polyethylene liner bag will then be twisted shut and secured with a metal tie or plastic tape. Chain-of-custody forms and any other pertinent sample documentation information will be placed in a resealable plastic bag and taped to the inside cover of the cooler. Custody seals will then be affixed to the cooler. All samples will be shipped overnight by express air service or, for a local laboratory, delivered by a courier or field sampling personnel. In the event that samples can not be shipped or delivered until the following business day, the packaged samples will be held overnight under custody at a WESTON facility with restricted entry (authorized personnel only).

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5.5 LABORATORY COORDINATION

Sample shipments, data packages, data validation, and document control are all part of sample management. All scheduling for sample containers, analytical work, and data dispersal will be arranged in close consultation with the laboratory. The following steps will require close interface with the laboratory:

- Reviewing the number of samples to be submitted for analysis.
- Reviewing the analytical requirements, bottles needed, blank requirements, and volumes required for sample analysis.
- Coordinating special analytical requirements with the laboratory QA manager.
- Determining the approximate dates sampling will occur and informing the laboratory.
- Scheduling sample container shipments.
- Informing the laboratory of the need for analytical results in both hardcopy and diskette formats.

Laboratory scheduling and oversight will be conducted through WESTON's Laboratory QA Coordinator for this project.

5.6 FIELD DOCUMENTATION

All daily field activities for the off-site investigation will be documented in indelible ink in a bound waterproof log book containing consecutively numbered daily field log forms. A separate daily logbook will be used for each investigation phase and may be used for each type of sampling event. At a minimum, the field crew will record the following information in the daily logbook:

- Date and time of entry (24-hour clock)
- Project name and location
- Project number
- Time and duration of daily sampling activities
- Weather conditions
- Variations, if any, from required sampling protocols and reasons for deviations
- Name of person making entries and other field personnel

PROCEDURES COMMON TO ALL FIELD INVESTIGATIONS

- On-site visitors, if any
- General methods of sample collection
- Transfer of the notebook

Field sample records specific to each type of sampling activity (e.g., surface sediment sampling or subsurface sediment coring) will also be maintained by field personnel.

5.7 INVESTIGATION-DERIVED WASTE MANAGEMENT

Investigation-derived waste (IDW) generated as a result of field activities detailed in this SAP will be managed in accordance with EPA Region 6 guidance as well as all applicable federal, state, and local regulations and will be handled in a manner consistent with ultimate disposition. IDW is anticipated to include the following categories of waste:

- Personal protective equipment—chemical protective clothing, nitrile gloves, etc.
- Decontamination wastes—various solvents, water, and potentially contaminated materials.

IDW will be segregated by waste type and anticipated hazard prior to disposal. Containers (e.g., drums) used for potentially hazardous waste materials (e.g., decontamination solvents, heavily soiled personal protective equipment, or grossly contaminated sediment) will be labeled with permanent and unique numbers on the tops and sides. The contents of each container, the date the contents were first placed in each container, and a contact's name and phone number will also be conspicuously noted on the exterior of the containers. In addition, containers will be labeled "Potentially Hazardous, Pending Analysis" and will be temporarily stored on pallets in a pre-determined location at the upland facility. An IDW plan for waste material analysis and disposal will be prepared and submitted after completion of all RI sampling activities.

5.8 CONTINGENCY ACTIONS

This section describes the procedures that will be followed if work elements must be changed during implementation of the off-site investigation SAP. The degree of change required (i.e., minor versus significant) will determine the type of response implemented.

PROCEDURES COMMON TO ALL FIELD INVESTIGATIONS

Minor changes are defined as those contingency actions that do not impact the substance of the investigation and may include, but are not limited to, actions such as moving sample locations a short distance from proposed locations (e.g., less than 50 feet) to accommodate a dedicated habitat, physical obstruction, or geologic condition, or collecting additional duplicate samples for archiving or analysis based on visual observations indicating unique or unusual sample characteristics.

Significant changes are defined as those actions that impact the substance of the investigation and may include, but are not limited to, events such as loss or deletion of samples, changes in analyses, or relocating sampling stations relatively large distances (e.g., more than 50 feet).

The WESTON Project Manager will determine whether a variation from the SAP constitutes a minor or significant change. Subsequent to this determination, the following procedures will be implemented:

- For minor changes, the WESTON Field Operations Coordinator or Laboratory QA Coordinator will obtain verbal approval from the WESTON Project Manager to implement the proposed contingency action(s) and will provide follow-up written documentation describing the action(s) implemented.
- For significant changes, the WESTON Project Manager will consult with and obtain verbal approval from the EPA Project Manager or their designated contact person prior to implementing any proposed contingency action(s) and will provide follow-up written documentation describing the action(s) implemented.

All written documentation describing departures from the SAP will be submitted to EPA as part of the weekly field sampling progress reports. Any deviations from the SAP will also be described in the RI report.

Table 5-2
Sample Handling Requirements for Off-Site Investigations

Analysis	Suggested Analytical Method	Type of Container	Field Handling Procedures	Minimum Volume Required	Sample Preservation	Sample Holding Time
Surface and Subsurface Sediment Chemical and Physical Analyses						
Metals	EPA 6010B & 7000 Series	One 4 oz. widemouth glass jar with Teflon cap liner	Collect representative sample	Fill jar to neck	Cool to 4°C; keep in dark	Mercury - 28 days Others - 6 months
SVOCs	EPA 8270C	One 8 oz. widemouth glass jar with Teflon cap liner	Collect representative sample	Fill jar to neck	Cool to 4°C; keep in dark	14 days (extract) 40 (analysis)
VOCs	EPA 8260B	One 4 oz. widemouth glass jar with Teflon cap liner	Collect representative sample	Fill jar to neck	Cool to 4°C; keep in dark	14 days
TBT	Krone, et. al.	One 8 oz. widemouth glass jar with Teflon cap liner	Collect representative sample	Fill jar to neck	Cool to 4°C; keep in dark	7 days
AVS/SEM	PSEP/EPA	One 40 oz. glass jar	Collect representative sample	Fill jar to neck	Cool to 4°C	7 days
TDS	EPA 160.1	1 – Liter Poly	Collect representative sample	Fill jar to neck	Cool to 4°C	7 days
Gravimetric Percent Moisture	ASTM D2216	One 32 oz. widemouth glass jar	Collect representative sample	Fill jar to neck	None	None
TOC	9060 PSEP Mod.	One 4 oz. widemouth glass jar with Teflon cap liner	Collect representative sample.	Fill jar to neck	Cool to 4°C; keep in dark	14 days

Notes:

SVOCs – Semi-volatile Organic Compounds

VOCs – Volatile Organic Compounds

AVS/SEM – Acid Volatile Sulfide/Simultaneously Extractable Metals

TBT – Tributyltin

TOC – Total Organic Carbon

PSEP/EPA – EPA 1991 Analytical Method of Determination of Acid Volatile Sulfide and Simultaneously Extractable Metals in Sediment. Office of Science and Technology.

ATTACHMENT E-1

SCOPE OF WORK LABORATORY ANALYTICAL SERVICES

**SCOPE OF WORK
FOR LABORATORY ANALYTICAL SERVICES
STATE MARINE SUPERFUND SITE
PORT ARTHUR, JEFFERSON COUNTY, TEXAS**

INTRODUCTION

Roy F. Weston, Inc. (WESTON®) will be conducting sampling activities from middle to late August through September at the State Marine Superfund Site (State Marine Site) located in Port Arthur, Texas. As part of these sampling activities, WESTON will be collecting soil, sediment, and water (surface and groundwater). These samples will require laboratory analysis for various parameters including semi-volatile organics (SVOCs), volatile organics (VOCs), and metals.

This document describes the Scope of Work (SOW) to be performed by the analytical laboratory selected to perform sample analyses for these sampling activities. The work is being conducted under the EPA Region 6 Rapid Response Contract. All work to be performed by WESTON and its Subcontractors will be conducted in accordance with Contract No. DACA45-98-D0004. The SOW describes the general tasks that the selected laboratory is to perform for the analyses of samples collected at the State Marine Site.

This document also serves as the basis for laboratory cost estimating for this project. WESTON requests that the laboratory submit firm and fixed unit pricing (which will not fluctuate due to variations in estimated quantities of samples requiring analyses) to perform the work described in the following subsections. The bidder is required to submit along with the proposal, proof of Historically Underutilized Business (HUB), if applicable, certification and a certificate of insurance.

NUMBER OF SAMPLES TO BE ANALYZED

The estimated number of samples to be analyzed is presented in the Bid Form provided as Attachment A.

ANALYSES TO BE PERFORMED

The laboratory analyses required may include the following:

- EPA SW846 Method 8270 low level detection for SVOCs
- EPA SW846 Method 8260B for VOCs
- EPA SW846 Method 8151M for pentachlorophenol
- EPA Methods 6010/200.8/7470/7471 for TAL metals
- EPA Method 9010B for cyanide
- Total organic carbon (TOC)
- Acid Volatile Sulfide/Simultaneously Extractable Metals (AVS/SEM)
- Gravimetric water content (% moisture)

Suggested laboratory reference methods for specific chemicals and conventionals are presented in detail in Attachment B.

All soil and sediment sample analytical results are to be submitted to WESTON based on dry-weight. The cost of obtaining this result (i.e., percent moisture) should be included in the laboratory's unit cost for each analysis.

TURN AROUND TIME

The laboratory should provide unit prices appropriate for each analysis and requested turnaround time (TAT) in the Bid Form provided as Attachment A. If a TAT for a specific analysis is not achievable then the term "N/A" should be entered into the worksheet cell.

PROJECT REQUIRED QUANTITATION LIMITS

The specific chemicals for each method and matrix are included as Attachment B. The chemical name, Chemical Abstract Service (CAS) Number, and estimated project-required quantitation limits (PRQLs) have also been provided.

The laboratory should notify WESTON if the quantitation limits are not achievable for any chemical and sample and document the reason for any variances in the Narrative Summary to be provided as part of the hard copy laboratory report.

SAMPLE DELIVERY TO THE LABORATORY

WESTON anticipates that the samples to be submitted to the laboratory will be collected and submitted on a daily basis throughout the estimated project duration. It is estimated that 10 samples, on average, will be submitted on a daily basis with the understanding that this number of samples may increase or decrease based on site activities. Based on the physical location of the laboratory, samples will be either picked up by the laboratory daily from the site or shipped to the laboratory daily via Federal Express (Priority Overnight). The cost of picking up or shipping the samples should be included in the laboratory unit price for the analyses. For estimation purposes only, the cost of shipping samples to the laboratory from the site should be based on shipping, on average, one 48-quart cooler weighing 30 pounds via Federal Express (Priority Overnight).

SAMPLING AND ANALYSIS MATERIALS

Sample containers, preservatives, blank labels, custody documents and shipping coolers will be the responsibility of the laboratory and will be delivered to the site at least one business day before commencement of sampling activities.

The laboratory will be responsible for providing other materials necessary to complete the sample analyses. Laboratory supplied materials will include any chemicals required for sample preservation (excluding ice), the laboratory analytical equipment, materials, and space necessary to conduct the work. The costs for these items should be included in the laboratory's unit price for the analyses.

SAMPLE DISPOSAL

The laboratory will be responsible for the legal disposal of the samples after sample analyses are completed per Article 18 of the Laboratory Services Agreement General Provisions. The cost for disposal should be included in the Laboratory's unit price cost estimate for the analyses.

LABORATORY DELIVERABLES

The laboratory will be responsible for providing Interim and Final Deliverable Report Packages to WESTON. The Interim Deliverable Report Package will consist of the following:

- Copies of the analytical results sent via facsimile to WESTON within the specified TAT.
- All information necessary to complete the tables within the Standard Operating Procedures (SOPs) provided in Attachment C sent via facsimile to WESTON within the specified TAT.
- An electronic data deliverable (EDD) with the analytical results per SOP 210.02 provided as Attachment D and other applicable information. The EDD will be transferred to WESTON electronically via modem or electronic mail. The cost of the EDD should be included in the laboratory's unit price for the analyses. If the electronic transfer of the data is not achievable then indicate so by providing applicable comments on the Bid Form under Miscellaneous.

The Interim Deliverable Report Package will be provided and transmitted to WESTON to meet the specified TAT. If the Interim Deliverable Report Package is not achievable for a specific TAT then the term "N/A" should be entered into the worksheet cell that represents the respective TAT.

The Final Deliverable Report Package should consist of all the information provided in the Interim Deliverable Report Package, but in final hard copy form, and should be provided within seven days of the laboratory's receipt of the last sample within a sample data group (SDG).

In general, the Interim and Final Deliverable Report Packages should be prepared in accordance with the EPA CLP National Functional Guidelines for Organic Data Review suitable for Level III Data Validation.

LABORATORY DATA QUALITY ASSURANCE

The selected laboratory will maintain a written Quality Assurance/Quality Control (QA/QC) Plan that describes the practices that the laboratories perform to maintain quality work. The QA/QC Plan should identify key laboratory personnel involved with QA/QC and describe general laboratory procedures for sample custody and tracking, instrument calibration and maintenance, and mechanisms for corrective actions. This QA/QC plan must be submitted to WESTON for review and acceptance at the time the cost estimate for this work is provided.

The laboratory will be responsible for the quality of all data that it generates and reports to WESTON. It is expected that the data presented will meet the quality control guidelines of the EPA CLP National Functional Guidelines, and that the results will be accurate and precise within framework of the uncertainties associated with the analytical methods. Furthermore, it is expected that the analytical results reported will reflect those determined during the analysis, and that the data

presented in the EDD will match the data presented by in the hard copy laboratory report. The laboratory will be responsible for the correction of any errors associated with data reporting.

The laboratory will be responsible for running and ensuring that a matrix spike/matrix spike duplicate (MS/MSD) analysis is completed for each batch of samples submitted from the State Marine Site. It will be necessary that the MS/MSD sample originates from one of the samples collected and submitted from the UCSS. The cost of analyzing and providing MS/MSD results should be included in the Laboratory's unit price for the analyses for all samples generated and submitted from the State Marine Site.

OTHER BIDDING INFORMATION

A Bid Form (see Attachment A) is attached for your use in returning your cost estimate to WESTON. Questions regarding this project should be directed to Jeff Criner of WESTON's Houston, Texas office at phone number (713) 985-6627. Cost estimates should be faxed to the attention of Drew Molly at (713) 985-6662 no later than 3:00 p.m., Tuesday, 10 July 2001.

BID FORM

**ANALYTICAL LABORATORY
BID FORM
STATE MARINE SUPERFUND SITE
PORT ARTHUR, JEFFERSON COUNTY, TEXAS**

ANALYTICAL PARAMETER	MATRIX	TAT (days)	Estimated No. of Samples	Unit Cost per Sample ¹	Total Cost
SVOCs and PCP	Soil	10	190		
		20	190		
		28	190		
	Sediment	10	90		
		20	90		
		28	90		
	Water ²	10	25		
		20	25		
		28	25		
TAL Metals and Cyanide	Soil	10	190		
		20	190		
		28	190		
	Sediment	10	90		
		20	90		
		28	90		
	Water	10	25		
		20	25		
		28	25		
Organotin (as TBT ion)	Sediment	10	90		
		20	90		
		28	90		
	Water	10	25		
		20	25		
		28	25		
VOCs	Water	10	5		
		20	5		
		28	5		
Total Dissolved Solids (TDS)	Water	28	5		
Total Organic Carbon (TOC)	Sediment	28	70		
AVS/SEM	Sediment	28	70		
Gravimetric Water Content	Sediment	28	70		

¹ Unit prices shall remain firm and fixed as specified herein and shall not fluctuate due to variations in estimated quantities of samples requiring analyses.

² Unit price should include providing results for pentachlorophenol as part of the SVOCs analyses and cyanide as part of the metals analyses.

AVS/SEM = Acid Volatile Sulfide/Simultaneously Extractable Metals

VOCs = Volatile Organic Compounds

SVOCs = Semi-Volatile Organic Compounds

TAL = Target Analyte List

TBT = Tributyltin

**ANALYTICAL LABORATORY
MISCELLANEOUS
STATE MARINE SUPERFUND SITE
PORT ARTHUR, JEFFERSON COUNTY, TEXAS**

1. EDD:

2. Comments:

ATTACHMENT E-2

SOP

SOP	0110.01				
GROUP	Database Management System				
SUB-GROUP	Data Collection and Acquisition				
TITLE	Sample Nomenclature				
DATE	7/19/01	FILE	0110-01.DOC	PAGE	5-9 of 1

INTRODUCTION

The following Standard Operating Procedure (SOP) presents the sample nomenclature for analytical samples in the On-Line Data Management system. The sample nomenclature is based upon specific code requirements for compatibility with the ARCS On-line system. A site specific data management plan should be prepared prior to sample collection.

PROCEDURE

SAMPLE NOMENCLATURE

Station ID - Collection Type + QC Type - Sequential Sample

Where:

Station ID: A three-digit identifier used to designate the particular physical location where the sample was collected.

Collection Type: A one-digit code used to designate what type of sample was collected:

1	Surface Water
2	Ground Water
3	Leachate
4	Field QC/Rinsate
5	Soil/Sediment
6	Oil
7	Waste
8	Other
9	Drinking Water

QC Type: A one-digit code used to designate the QC type of the sample:

1	Normal
2	Duplicate
3	Rinsate Blank
4	Trip Blank
5	Field Blank
6	Confirmation

Sequential Sample: A one-digit code that represents the nth sample of common Collection Types.

Example: *054-51-3* Represents the third normal soil sample collected at Station 054.

054-52-3 Represents the duplicate of the third soil sample at Station 054.